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Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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Problems of Geochemistry.

IN his recent lecture at the Royal Institution, parts of which are reproduced in this issue of NATURE, Prof. V. M. Goldschmidt presented a brilliant summary of the broader problems of geochemistry and of some of the conclusions that have been reached in the effort to solve those problems. His view of the concentric architecture of the earth, and in particular of the 'eclogite' and 'sulphide-oxide' shells, is one that has received much more attention on the Continent than in the English-speaking countries. In Britain and America the substratum between the crust and the core is more generally supposed to be of the composition of peridotite. More important, however, than a reminder of such differences of opinion, is Prof. Goldschmidt's summary of the principles which enable geochemistry to enter into partnership with geophysics in the difficult investigation of our planet's hidden depths. The laws that govern the vertical distribution of the chemical elements, their partition between the different shells of the earth, are gradually being recognised, and their integrated effects can be tested by an appeal to the zones that are accessible to observation. Conversely, the composition of these zones affords a valuable series of clues as to the nature of the deeper layers. In particular, the abundance of iron among the predominating lithophile elements of the crustal rocks gives a clear indication that iron must be the chief constituent of the core. Confirmatory evidence is forthcoming from the samples of other cosmic bodies which, as meteorites, are captured by the earth. They, too, have their nickel-iron phases and their silicate phases, in close analogy with the composition assigned on

technological grounds to the principal parts of the earth.

The analogy is, unfortunately, not a safe one to follow too far, since many meteorites bear distinct signs of having had a volcanic origin, and none that has yet been discovered represents the mineral assemblage of the high-pressure or 'eclogite' facies of silicate rocks. Nevertheless, meteorites provide precious data bearing on the natural association of elements, and these, together with spectroscopic evidence of the composition of stellar atmospheres, are found to be closely in accordance with the associations characteristic of our own terrestrial materials.

Less speculative, but of absorbing interest and economic importance, is Prof. Goldschmidt's discussion of the concentration of the rarer elements in the residual liquors of magmas. Corresponding with his deduction that two very different types of elements would be expected to remain in the final liquors, we find in pegmatites minerals of elements with very small atomic sizes (for example, lithium, boron, and fluorine) associated with others containing the large-size elements (for example, zirconium, thorium, uranium, niobium, and tantalum). It has frequently been asserted that the heavy radioactive elements might be expected to be concentrated in the deeper and heavier levels of the earth's interior. The geochemistry of both igneous rocks and meteorites affords no support to this superficial view, but indicates, on the contrary, that these markedly lithophile elements, ultimately sorted out in virtue of their atomic sizes, should be steadily concentrated in the uppermost levels of the earth's crust, the effect being cumulative with each successive igneous cycle.

Geochemistry has before it a broad and attractive field to cultivate. Not only the *vertical* distribution of elements, but also their *horizontal* distribution needs to be correlated with geological structure and geological history, and finally there remains for much further study the geochemistry of the secondary geological processes such as weathering, sedimentation, and metamorphism. Prof. Goldschmidt, more than any other single investigator, has developed the principles and methods most likely to yield a rich harvest. They deserve particular attention in Great Britain, where geochemistry has been somewhat neglected, for, as his stimulating lecture clearly reveals, their application to problems of petrogenesis and ore-deposition, as well as to the material aspects of geological processes in general, is already achieving a series of encouraging results.

Low-Temperature Carbonisation.

The Technology of Low Temperature Carbonizatio
By Frank M. Gentry. Pp. xvii + 399. (London Baillière, Tindall and Cox, 1928.) 34*s*. net.

WHEN coal is burned in open grates, an indeed, in many industrial furnaces, large proportion of the volatile contents of th coal escapes into the atmosphere unburnt, or bu partially burnt, in the form of oily vapours an particles of soot. The resulting pollution of th atmosphere, particularly in large residential centre is a serious civic problem, resulting in much defac ment of buildings and impoverishment of health.

With, possibly, one or two exceptions, our smok abatement laws are framed to restrict the discharg of smoke from industrial stacks as distinct fro domestic chimneys. In most large cities, howeve the smoke nuisance arises mainly because bitumino coal is burned in domestic grates.

The discharge of smoke from industrial stacks much less to-day than it was twenty years ag because the scientific investigation of combusti processes has led to a great improvement in th design and operation of furnaces. With few e ceptions, the discharge of smoke from a facto stack is unpardonable and indicates a lack scientific control in the furnace room.

The increasing use of gas and electricity, and th correspondingly diminished amount of bitumino coal that is burnt in domestic fireplaces, is reflecte in lower concentrations of smoke in the atmosphe above large cities. There still remains, howeve much room for, and indeed much need of, im provement, and this improvement can be broug about mainly by preventing the discharge of smo from domestic chimneys. To some extent th will be accomplished automatically by the furth development of gas and electric heating. It unlikely, however, that coal as a domestic fu will be completely displaced by these alternativ for many years to come.

It is possible to prevent this smoke formati by removing the volatile constituents from t coal before it is burnt in the grate. This is alrea done in the gasworks, but the resulting coke difficult to ignite and cannot readily be burnt domestic grates. If the volatile constituents cou be removed from the coal and a residue be obtain which would burn freely and give out plenty heat, and which could be obtained at a pri comparable with that of coal and, at the same tim yield a profit on the undertaking, the use of th residual material would, conceivably, becor

neral and the discharge of smoke from domestic mneys would become a thing of the past.

This is one motive for the investigation of the -temperature carbonisation of coal. There is ther: To the chemical engineer, coal is some-ng more than a fuel; it is a complex raw terial, from which, by suitable means and with appropriate plant, many valuable liquid and seous products can be obtained, leaving a solid idue which is still a valuable combustible. These ducts may be used in various ways—for example, fuel for internal combustion engines, as lubri-nts, as fertilisers, or as starting materials for the nufacture of a wide range of organic compounds. To separate a volatile fuel oil from coal and burn in an internal combustion engine is to use it re conveniently and more efficiently, so that form value is increased. To use a separated nstituent as a raw material in chemical industry better than burning it, however efficiently, along h the parent coal.

The problem before the chemical engineer, there-e, is the development of a process by which the l potential chemical value of the coal can be lised most completely, not simply by burning coal with the highest efficiency under a boiler, even in powdered form in an internal combustion gine, if that were possible, but by obtaining its ious components in the forms in which they l possess the highest industrial value. The mediate problem of low-temperature carbonisa-n is the design of a retort in which the preliminary aration can be carried out efficiently and nomically.

To some extent this ideal has been realised in the product recovery coke oven and the gas retort; ng to the high temperature at which these cesses operate, however, a large proportion of volatile constituents of the coal is converted gas. By carrying out the destructive distillation he coal at lower temperatures, it is possible to ain a smaller proportion of gas and a corre-ndingly greater quantity of oils. The solid bonaceous residue, unlike the products of the e oven and the gas retort, is very reactive, ites readily, and burns on a domestic grate freely without smoke. Its superior reactivity may ke it suitable for special purposes and ultimately ance its market value. Low-temperature, or imary', tar differs both chemically and physic-from the high-temperature tar from gas rts or coke ovens. A special technique has yet e worked out for its subsequent treatment and luation.

Most of the earlier work on low-temperature carbonisation was carried out in Great Britain and in Germany; a considerable amount of work has also been done in America. Some hundreds of processes have been worked out in the laboratory; many of these have been worked on a semi-technical or technical scale, and a few of them are now being operated tentatively as large industrial units.

It is difficult, at present, to estimate the economic possibilities of low-temperature carbonisation. An immense amount of work has been done upon the design of a suitable retort, particularly in relation to the materials of construction, the movement of the charge through the retort, and the economical utilisation of the heating medium. Economic success will also depend upon the market value of the products. This value cannot yet be fully realised, for the subsequent separation and utilisation of the somewhat peculiar products still remain to be worked out. It would seem that ultimate success depends upon reducing the cost of carbonisation below a few shillings per ton, discovering new uses for primary tar and gases so as to make them more valuable than the present by-product tar and gas from high-temperature processes, or finding a use for the solid residue which will enable it to bring in a revenue equivalent to the original value of the coal. It is possible that, when satisfactory processes are developed, they may be encouraged by a Government subsidy in the interests of public health and civic well-being.

Mr. Gentry has done a great service to all who are interested in the more effective utilisation of coal by writing a most excellent and comprehensive critical account of the work that has already been done in this field. He has produced a book of nearly four hundred pages which is packed with trustworthy information and sound criticism. After a preliminary chapter dealing with the fundamental principles involved in the heating and destructive distillation of coal, separate chapters are devoted to the production and properties of the various products of low-temperature carbonisation: gas, tar, coke, and nitrogenous and other by-products. In each chapter, the various factors which affect the yield and character of the particular product, such as the character of the coal, the rate of heating, the character of the gaseous atmosphere and the secondary decomposition of primary products, are clearly discussed. Some fifty pages are then devoted to a detailed description of a number of typical plants and processes, the characteristic features of each being well described. After a valuable chapter dealing with the design and operation of

different retorts, the behaviour of various construction materials under low-temperature carbonisation conditions and the transfer of heat through these materials, the book closes with a thoughtful and stimulating chapter in which the economics of low-temperature carbonisation are carefully considered. Such important matters as the yields of the different products and the resulting revenue, capital and operating costs, actual and potential markets for the different products, and the influence of plant location and fuel supplies, are discussed fully.

This is the best up-to-date account of the subject that is known to the reviewer. The immense amount of information is handled in a masterly manner; it has been well chosen; it is arranged logically and clearly; the conclusions are well found and clearly presented. The book is well illustrated. Its value is enhanced by more than four hundred references to original papers.

The book can be commended confidently to all who need a clear and authoritative account, from the theoretical or practical aspect, of the low-temperature carbonisation of coal. W. E. G.

Mathematical Notation through the Centuries.

A History of Mathematical Notations. By Prof. Florian Cajori. Vol. 1: *Notations in Elementary Mathematics.* Pp. xvi + 451. (Chicago and London: The Open Court Publishing Co., 1928.) 25*s.* net.

THE work before us constitutes an important contribution to the history of mathematics. The development of mathematical notation is a fascinating subject in itself; but, the literature being so vast and scattered, it is difficult, without such a guide as is here presented, to study it effectively; in fact, apart from such a vademecum, it would be necessary to spend years (almost) in studying the original documents in the great libraries. Now, however, thanks to the labours of Prof. Cajori, which must have been colossal, we are given a conspectus of the whole subject so far as elementary mathematics are concerned.

The work was originally intended to be brought out in one volume, but the author, on second thoughts, decided (wisely, as we think) to divide it into two volumes, and to confine the first of the two to the history of symbols in elementary mathematics, "since such a volume would appeal to a wider constituency of readers than would be the case with the part on symbols in higher mathematics". As it is, the volume before us is as larg as can be conveniently handled. It contains however, everything which a student of the subjec is likely to require. Besides many hundreds c references to the literature, it gives extracts fro all the known books, from the invention of printin onwards, which are significant from the point c view of notation, more than a hundred facsimile of printed pages, and reproductions of simila matter from MSS. showing still earlier stages in th development of various signs.

After a page of introduction, Part II. deal with numeral systems and symbols (Babylonian Egyptian, Phœnician and Syrian, Hebrew, Cretan Greek, early Arabian, Roman, Peruvian, Azte Maya, Japanese, Chinese, and finally the Hindu Arabic numerals). Part III. is devoted to th symbols used in arithmetic and elementary algebra and Part IV. to those belonging to elementar geometry. Part III. is in two sections. Th first (A) describes the symbols, in chronologica order as it were, under individual authors, Greek Hindu, Arabic, Byzantine, and finally medieva and modern, the latter arranged according t periods and countries. This section contains th facsimiles of passages from MSS. and of printe pages from the earliest printed arithmetic (th Treviso Arithmetic, 1478) onwards. Among ther are specimens from MSS. of Nicole Oresme (14th c. Regiomontanus and Nicolas Chuquet (15th c.), an printed pages of works by Paciuoli, Cardano Tartaglia, Bombelli, Widman, Schreiber (Gram mateus), Christoff Rudolff, Stifel, Stevin an Girard, Nuñez, Recorde, Leonard and Thoma Digges, Peletier, Vieta, Harriot, Hérigone, Descartes Barrow, Rahn, Wallis. There is also an elaborat account of the symbols (some 150 in number) use by William Oughtred, whose influence in thi regard was second to none; after him the importan names are those of Barrow, Wallis, and Leibniz.

In reading Section A of Part III. the reader i in danger of not seeing the wood for the trees, s bewildering is the variety of the symbols used b the several authors; but here Section B come to our assistance. In this, Prof. Cajori gives wha he calls a "Topical Survey of the Use of Notations" The object of the history is, as he says, to give no only the first appearance of a symbol and its origi (where possible), but also to indicate the competi tion encountered and the spread of the symbol among writers in different countries, the rise c certain symbols, their day of popularity, thei eventual decline, and so on. It is this specia survey in Section B which is perhaps the mos

luable portion of the work, for in it the author esents " a mirror of past and present conditions mathematics ", in the belief that " the successes d failures of the past will contribute to a more eedy solution of the notation problems of the esent time ".

Among interesting details in the volume we may te the following. It is curious to find that the nification of numbers by knots in strings appears Peru under the Incas and also in the earliest inese system, that the Maya of Central America d a numeral system which was vigesimal except the second step, where 18 took the place of 20, d that the Maya system exhibited the principle ' place value ' and the use of a symbol for zero out the beginning of the Christian era, and erefore centuries before the Hindus began to e their symbol for zero.

It appears that the + and − signs used in print the first time by Widman (1489) are found in S. of 1481 and 1486, now at Dresden, which re studied and annotated by Widman. The n = for equality, which we owe to Robert corde (" The Whetstone of Witte ", 1557), ms to have been used independently about the ne time (between, say, 1551 and 1568) by a thematician at Bologna. The signs > and < ' greater than ' and ' less than ' are due to rriot (1631); they ousted less convenient signs d by Oughtred about the same time. A iosity is Hérigone's use of ' 2|2 ' for ' equal ', 2 ' for ' greater than ', and ' 2|3 ' for ' less than ' 34, 1644). Descartes used for ' equal ' a sign e our sign for ' varies as ', but turned the other y; the sign for ' varies as ' was introduced by Emerson (" Doctrine of Fluxions ", 3rd ed., 8). The sign × for multiplication was first d by Oughtred; the substitution for it of a ple dot is due to Leibniz (about 1698). ÷ for ision was introduced by the Swiss, Johann nrich Rahn (" Teutsche Algebra ", 1659); it l previously been used in the sense of ' minus ' lam Riese, 1525), and, very oddly, persisted in t sense in German and Scandinavian countries il the nineteenth and even the twentieth century. Oughtred first represented proportion by B :: C . D (1631); but so early as 1651 Vincent ng wrote A : B :: C : D; Leibniz substituted B = C : D in 1693. The struggle between these ations is well described (pp. 286-297), as also contest between the German + and − and the ian and French p and m for plus and minus 135-6); the latter lasted for about 130 years. competition between signs for radicals was more bewildering; " altogether there were at the close of the sixteenth century twenty-five or more varieties of symbols with which the student had to be familiar if he desired to survey the publications of his time ". The sign ∴ for ' therefore ' appears for the first time in Rahn's " Teutsche Algebra " (1659), with ∵ as a variant. This book was translated into English by Thomas Brancker and published in 1668 with additions by John Pell, the sign ∴ for ' therefore ' being thenceforth adopted, with a tendency to use both ∴ and ∵, until the latter sign came to be appropriated for ' because '. The sign ∞ for infinity was first used by Wallis (1655).

In the region of elementary geometry there have always been sharp divisions of opinion on the advisability of using symbols and the proper limits to their use. Barrow and Wallis, for example, were enthusiastic for symbols. Wallis used so many in his ' De sectionibus conicis ' that Thomas Hobbes protested: " And for your conic sections, it is so covered over with the scab of symbols that I had not the patience to examine whether it be well or ill demonstrated." . . . " Symbols are poor, unhandsome, though necessary scaffolds of demonstration . . . though they shorten the writing, yet they do not make the reader understand it sooner than if it were written in words. For the conception of lines and figures . . . must proceed from words either spoken or thought upon. So that there is a double labour of the mind, one to reduce your symbols to words, which are also symbols, another to attend to the ideas which they signify." The reaction, so far as geometry is concerned, came with Keill's and Simson's editions of Euclid (1713 and 1756). Keill, referring to Barrow's Euclid, wrote: " Barrow's demonstrations are so very short and are involved in so many notes and symbols that they are rendered obscure and difficult to one not versed in geometry. There, many propositions which appear conspicuous in reading Euclid himself, are made knotty, and scarcely intelligible to learners, by his Algebraical way of demonstration." The influence of Simson lasted until the time of Todhunter's edition.

It is a pity that, in a few cases, Prof. Cajori does not seem to have used the latest editions of the texts. Thus the form of the quotations from Diophantus and Heron on pp. 26, 27 would have been slightly different if they had been taken from Tannery's and Heiberg's editions rather than those of Bachet and Hultsch. The reference to Diophantus' " Arithmetica, vol. 4, p. 17 " should be to Prop. 16 of Book 4 of that work. T. L. H.

Plants of the Balkans.

The Plant-Life of the Balkan Peninsula: a Phytogeographical Study. By Dr. W. B. Turrill. (Oxford Memoirs on Plant Geography.) Pp. xxiii + 490 + 10 plates. (Oxford: At the Clarendon Press; London: Oxford University Press, 1929.) 30*s.* net.

THE valuable series of memoirs on plant-geography edited by Profs. Engler and Drude under the title "Die Vegetation der Erde" is familiar to every well-equipped botanist. But, as Prof. A. G. Tansley remarks in his editorial preface to the present volume, it is scarcely creditable to the Empire which possess in its dominions, colonies, and dependencies more varied vegetation than any other political entity, that Dr. Leonard Cockayne found himself obliged to publish his work on New Zealand in the German series. It is hoped that Dr. Turrill's memoir on the plant-life of the Balkan Peninsula may inaugurate a channel of publication to be known as the Oxford Memoirs on Plant Geography, and that the enterprise will be adequately supported.

Dr. Turrill's special interest in the Peninsula began with his service with the British Salonica Forces during the War, since when he has paid three visits to the area. His position as assistant in the Kew Herbarium has given ample opportunity for the detailed taxonomic work. The result is an authoritative combination of a taxonomic and ecological study of the area, embodying a vast amount of information conveyed in a more or less readable form.

The penalty of specialisation is brought home to the reader when perusing a volume such as this. The presentation of the plant-life of an area, so full of botanical interest as is the Balkan Peninsula, should appeal to every true botanist, and we would suggest to the editor that a glossary of the less common technical terms would smooth the way for the reader of those future memoirs which will, we trust, follow Dr. Turrill's.

The Balkan Peninsula is an irregularly triangular mountainous land-mass projecting from its base in Central Europe into the Mediterranean basin, and representing two main climatic areas, the Central European and the Mediterranean. Crete and the other islands to the south and east are also included in the survey. In the earlier chapters, Dr. Turrill describes in detail the physical features of the score or so of districts into which he subdivides the area, the geology and soil-characteristics, and the climate. Successive chapters are given to duration and life-forms of the species, flowering periods, habitat classification, altitudinal zonation, plant-communities, plant-succession, influence of man, cultivated crops, a summary of floristic and phytogeographical data for the families of flowering plants represented, plant-dispersal, floristic and vegetational distribution within and outside the Peninsula, and endemic and relict species and the age and area hypothesis, and finally there is a brief chapter of general conclusions.

The flora of the Peninsula is richer than that of any other area of equal size in Europe, not only in number of species but also of endemics, and amongst the latter are many relicts of the Tertiary flora. Two main types of flora and of vegetation are recognised: the Mediterranean, characterised by species adapted to surviving a summer drought, and the Central European, composed of species having a winter resting phase. The author lays great stress on the modifying influence of man, who especially by forest destruction, has induced enormous changes in the flora and vegetation. Brush-woods, heaths, stony grassland, and rock-communities occupy much ground which should, under the existing climatic conditions, be covered with high forest. Hence species suited to such habitats have been able to extend their distributional areas, and much hybridisation has resulted from their resulting contact with other species. Turrill emphasises the importance of a study of the least disturbed parts of the Peninsula, such as the Rodope massif and the Strandja Planina, before the natural vegetation is further destroyed or modified by man's exploitation.

The absence of a continuous impassable barrier separating Central Europe from the Balkan Peninsula has made the latter the most important 'area of refuge', as evidenced by the number of relict species and types, dating from Tertiary times. Owing to the comparatively small influence of the Ice Age on its flora, the botanical history of the Peninsula has been more static than that of northern Europe, and Dr. Turrill indicates its importance as a centre of species-making and dispersal, especially with regard to the ancient land-mass, the old core of the Peninsula, centred in the Rodope massif.

The illustrations include a folding map and a few photographic reproductions of the vegetation. The book is very clearly printed, but the distribution of the margins on the pages suggests that the text has slipped bodily towards the top and the effect is not pleasing.

A. B. R.

Our Bookshelf.

he Concise Oxford Dictionary of Current English. Adapted by H. W. Fowler and F. G. Fowler from *The Oxford Dictionary*. New edition, revised by H. W. Fowler. Pp. xv+1444. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 7*s.* 6*d.* net.

HIS is so far the best of the smaller and cheaper nglish dictionaries that comparison seems almost dicrous. We have a book of nearly 1500 pages, ell printed and stoutly bound, for seven and six-nce. Simply as a book, it must be the cheapest ing now on the market. But the contents de-rve a close examination, and increase at every ep our admiration.

The book is based on the great "Oxford Diction-y" which alone made it possible. The first edition, hich was published in 1911, was compiled when e great book had only reached the letter R. that time the Fowlers, who are responsible this smaller work, drew for the later letters Skeat, the "Century", and other standard books en extant. The completion of the O.E.D. has w enabled Mr. H. W. Fowler, who is alone sponsible for this new edition, to revise in e light of the latest authority. He has pro-ced a dictionary which will probably become e handy daily book of reference for everyone o writes, and is quite sufficient for ordinary ucational purposes. It contains more than ty thousand words, and abundant phrases strating their use. These are not quotations m named sources; for that one has to refer to e original work. But they are specially chosen exhibit the language as a living thing. They , in fact, rather colloquial and current than rary, and this is why the book will have its great gue and serve to build up as well as restrain the wth of English in the rising generation. It will used side by side with the same author's "Modern glish Usage".

Testing the dictionary here and there on entific words, we find that it contains more n any other of like size and scope, but that ference is given to words deriving from the er established sciences, especially mathematics, r newer words arising, say, from biology. ite a sound and useful definition is given of tegral', 'differential', 'potential', but nothing 'dominant', 'recessive', etc., in the Mendelian se. This is mentioned not so much as a fault to indicate the sort of line that has been taken. e book is a marvel of cheapness, compression, l good judgment on the lines indicated by its rce and its purpose. F. S. M.

mentary Laboratory Experiments in Organic Chemistry. By Prof. Roger Adams and Prof. John R. Johnson. Pp. xi+304. (New York: The Macmillan Co., 1928.) 8*s.*

E authors describe this book as a "laboratory nual designed for first semester students in anic chemistry". It offers a carefully planned es of practical exercises permitting of com-binations to suit various circumstances. Examples of operations illustrating the general principles of purification, etc., are followed by some forty representative preparations. Many of the latter are naturally 'hardy annuals', but we notice the introduction of *n*-butyl alcohol in an instructive sequence of operations leading up to *n*-valeric acid. Noteworthy also is the 'subjective' synthesis by the student, *in vivo*, of hippuric acid.

The experimental details and precautions are exactly stated throughout and are quite up-to-date: thus, acetaldehyde is prepared by de-polymerising paraldehyde, and valuable hints—too often omitted—are given in the accounts of acet-amide and acetanilide. The authors suggest that the inclusion of such details as the amounts of washing and drying agents to be used may arouse criticism; but probably most experienced teachers will agree that it is almost impossible to be too precise in initiating students into a correct laboratory routine in this subject. The emphasis laid in the foreword upon accuracy and neatness is also very necessary. A useful appendix contains tables of densities, etc., and also summaries of the materials and time required for each experiment. It should be mentioned that the work does not comprise the identification of organic substances.

The book is economically but adequately illus-trated, and it is well printed on a good paper which should withstand ordinary laboratory wear. The leaves are perforated and printed on one side only, so that the experimental sheets may be detached as required; incidentally, the blank pages are reckoned in the pagination. The volume can be confidently recommended as an excellent medium for effecting the introduction of students to the practice of organic chemistry. J. R.

Section de Géodésie de l'Union Géodésique et Géophysique internationale. Publication spéciale No. 2: *Tables de l'Ellipsoïde de Référence international adopté par l'Assemblée générale de Madrid le 7 octobre 1924 dans le système de la Division sexagésimale de la Circonférence.* Calculées sous la direction du Général G. Perrier par E. Hasse. Pp. 20+91. (Paris: Union Géodésique et Géophysique internationale, 1928.)

THE Section of Geodesy of the International Union of Geodesy and Geophysics decided at its 1924 meeting, in Madrid, to adopt an international ellipsoid of reference for geodetic measurements, and chose Hayford's ellipsoid, with the ellipticity 1/297·0 and major semi-axis 6378·388 km. as its primary elements. The secretariat was charged to publish tables of reference for this ellipsoid both for the sexagesimal and centesimal measures of angle: the present volume fulfils the first of these tasks. The tables, printed from typewritten sheets, are legible, well arranged, and well bound, as befits a work of reference. They give, to ten decimal places, for each minute of latitude, the logarithms of N, ρ and $\sqrt{N\rho}$, where N is the principal normal or radius of curvature of a meridian section, and ρ is the other principal radius of curvature; also, to six decimals, the logarithm of the factor of spherical

excess, the length of 1′ arcs of parallels to 0·01 mm., and, to 1 mm., the lengths of meridian arcs from the equator to each minute of latitude.

Physik: ein Lehrbuch für Studierende an den Universitäten und technischen Hochschulen. Von Prof. Wilhelm H. Westphal. Pp. xvi + 536. (Berlin: Julius Springer, 1928.) 18 gold marks.

PROF. WESTPHAL'S book is intended to be an elementary outline of physics, based upon our modern views of the structure of matter, and it is obviously based upon considerable teaching experience. It deals mainly with what we should term rather advanced intermediate physics, and the author introduces sections on entropy, the Nernst heat theorem, the electron theory of conduction, the ratio of the electrical units, thermomagnetic phenomena, the Zeeman effect and black body radiation, which are not usually found in English intermediate text-books of physics. The chapters on the quantum theory and the theory of matter and on the theory of relativity would certainly not be found in English intermediate text-books. These chapters are, of course, designed for beginners, and the former chapter even includes sections on wave mechanics and on the recent work of Sommerfeld on the electron theory of metals. The book is exceedingly well written and well illustrated. It is a book which a teacher may well recommend to an advanced intermediate student who wishes to study German.

The Science of Flight: Aeroplanes, Seaplanes and Aero Engines. By Capt. P. H. Sumner. Pp. xv + 292. (London: Crosby Lockwood and Son, 1928.) 25*s.* net.

Two years ago, Capt. Sumner published the first of his two volumes on "The Science of Flight and its Practical Application", in which he confined his attention to the development of airships and kite balloons, the scientific principles involved, and the construction and equipment of such machines. This second volume completes the review of the subject, and though his descriptions refer almost entirely to work done in Great Britain, there is a short historical chapter dealing with the early work of Lilienthal, Langley, Orville and Wilbur Wright, and other pioneers, and also with some of the memorable flights of recent years.

One chapter is devoted to the principles of aerodynamics, another to the airscrew, another to the general construction of aircraft, and a fourth to aeronautical instruments. A chapter on petrol engines in general is followed by descriptions and particulars of such famous engines as the Bristol Jupiter, the series of Armstrong Siddeley engines, the Napier Lion engine, the Rolls Royce and other engines, and the dimensions and performances of many well-known machines are included.

The People of the Twilight. By Diamond Jenness. Pp. x + 247 + 16 plates. (New York: The Macmillan Co., 1928.) 12*s.* 6*d.* net.

MR. JENNESS, as a member of the Canadian Arctic Expedition of 1913–18, spent two years with the Eskimo around Coronation Gulf. His headquarters were Bernard Harbour, and he made long visits to the little-known trade station in the south-west of Victoria Island. In these visits he cut himself off from the habits of the white man and lived the life of the Eskimo. The result is one of the most intimate studies of Eskimo habits and ways of life that has yet been published. He writes well, with sympathy for his friends and a real understanding of their problems. Although the book is meant for popular reading, it is one of the most valuable works on Eskimo life that has yet appeared. It adds much also to our knowledge of the natural history of the Canadian Arctic.

Einleitung in die Mengenlehre. Von Prof. Dr. Adolf Fraenkel. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 9.) Dritte umgearbeitete und stark erweiterte Auflage. Pp. xiv + 424. (Berlin: Julius Springer, 1928.) 22·60 gold marks.

THE theory of aggregates is a very difficult subject on the border line between mathematics and philosophy, and many questions of the first importance are still unsettled. Indeed, it may be said that the subject is more unsettled now than when Prof. Fraenkel first published his book (1919). In this, the third edition, revised and considerably enlarged, he has endeavoured to give an impartial account of different views, including those of Russell and Whitehead, which until recently have been too little known in Germany. Finally, the author sums up and gives his own personal views but modestly mentions that these may have to be modified in the near future. Prof. Fraenkel's book appears to be one of the clearest expositions available of an extremely abstract branch of science.

H. T. H. P.

Feelings and Emotions: the Wittenberg Symposium. By Alfred Adler, F. Aveling, Vladimir M. Bekhterev, Madison Bentley, G. S. Brett, Karl Bühler, Walter B. Cannon, Harvey A. Carr, Ed. Claparède, Knight Dunlap, Robert H. Gault, D. Werner Gruehn, L. B. Hoisington, D. T. Howard, Erich Jaensch, Pierre Janet, Joseph Jastrow, Carl Jörgensen, David Katz, F. Kiesow, F. Krueger, Herbert S. Langfeld, William McDougall, Henri Piéron, W. B. Pillsbury, Morton Prince, Carl E. Seashore, Charles E. Spearman, Wilhelm Stern, George M. Stratton, John S. Terry, Margaret F. Washburn, Albert P. Weiss, Robert S. Woodworth. Edited by Martin L. Reymert. (The International University Series in Psychology.) Pp. xvi + 453. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1928.) 28*s.* net.

THIS volume forms a handy means of reference to some of the more characteristic views of several distinguished psychologists. The papers, thirty-four in number, were delivered during a period of four days in the October of 1927 on the occasion of the inauguration of the new Psychological Laboratory at Wittenberg College, Springfield, Ohio.

Letters to the Editor.

e Editor does not hold himself responsible for pinions expressed by his correspondents. Neither an he undertake to return, nor to correspond with he writers of, rejected manuscripts intended for this r any other part of NATURE. *No notice is taken f anonymous communications.*]

East African Archæology.

N view of the various references to the work of East African Archæological Expedition which e appeared from time to time in the News and ws columns of NATURE during the past few nths, and with special reference to Mr. E. J. yland's letter in the issue of April 20, p. 607, we uld be grateful for the opportunity of briefly lining our results and conclusions up-to-date.

While definitely holding that there is a direct relation between the glacial phases of Europe l the Pluvials of the equatorial belt, we consider t in view of the divergencies of scientific opinion ncerning the number and sequence of European ciations, a complete correlation is at present mature.

Although preliminary work in the Nakuru-nenteita basin suggested that there had been five tinct wet periods (which we provisionally termed , 1st, 2nd, and 3rd Pluvials, with a Post-pluvial phase) more detailed investigation in this and er basins has led to the conclusion that there are y two Pluvials of the first magnitude. The first these is our original '0th Pluvial' and seems to e antedated much of the faulting in this part the Great Rift Valley. The deposits of this vial belong to the series which Prof. J. W. Gregory ludes in his Nyasan series (see "The Rift Valley l Geology of East Africa", p. 171) which he dates e think on insufficient evidence—as lower Miocene. e second major pluviation is subdivided by a dry iod of only short duration and comprises our inal 1st and 2nd Pluvials. At the close of this vial there was a period of great aridity which was owed by a renewal of pluvial conditions for a rt time. This is our original 3rd Pluvial. Another still smaller wet period is recorded by a fresh rise he lakes at a comparatively recent date.

n order to avoid the use of ordinals in referring he Pluvial periods, we have proposed the following nenclature for the Pluvial periods which we have ar recognised :

Old Name.	*New Name.*
h Pluvial.	Eburrian, 1st major Pluvial.
st Pluvial.	Enderian \ 2nd major
nd Pluvial.	Gamblian / Pluvial.
rd Pluvial.	Makalian.
ost-pluvial wet period.	Nakuran.

While avoiding for the present a more complete ial-pluvial correlation, we suggest that our second or Pluvial—the Enderio-Gamblian—can be cor-ted with the Würm (or Riss and Würm) glacia-s, or preferably with the 'Newer Drift' of northern rope. We agree with Mr. Wayland in regarding Makalian as probably the equivalent of the Bühl lium. Many implementiferous horizons have n established in the Pluvial deposits and we end a table setting out the relation of the various ures to the changes of climate. In view of the at similarity of certain of our cultures to those of Europe, we have ventured to employ the accepted European terminology while *emphasising* that by so doing we do not in any way suggest that the cultures in Kenya were necessarily contemporaneous with

Period.	Culture.
Nakuran	Contemporary: (*a*) A culture which is comparable to the Wilton of South Africa. (*b*) A culture which consists of a degenerate Aurignacian type of tool associated with pottery, agriculture, and also beads of a type which suggest a contact with one of the early civilisations. (Human type, Nakuru man.)
Makalian	A specialised form of Aurignacian culture associated with pottery. (Human type, Elmenteita man.)
Gamblian: (2) Closing stages	Contemporary: (*a*) Upper Aurignacian. (*b*) Highly specialised Mousterian, probably due to Aurignacian influence.
(1) Rise and maximum.	Contemporary: (*a*) Lower Aurignacian gradually developing into Upper Aurignacian. (Human type, Gamble's cave man.) (*b*) Upper Mousterian with a marked tendency to trimming of both flake-surfaces towards the close of the period.
Enderian	Contemporary: (*a*) Crude lower Aurignacian. (*b*) Lower Mousterian.
Eburrian-Enderian Interpluvial.	A single culture comprising large degenerate forms of ovate, very small, well-made *coups-de-poing* and flake tools with a distinct Mousterian tendency.
Eburrian: (2) Closing stages	A very fine Acheulean industry with the *S*-twist a common feature.
(1) Rise and maximum.	?

their European homologues. A large mammalian fauna has been collected from the deposits of the various Pluvials with the exception of the Eburrian, but pending investigation by a competent specialist, it is impossible to use them for correlation purposes.

L. S. B. LEAKEY (Leader).
J. D. SOLOMON (Geologist).
East African Archæological Expedition,
P.O. Elmenteita, Kenya,
May 29.

The Problem of Form in Physics and Biology.

IT is not unusual to hear statements that a characteristic feature of physical phenomena, as opposed to the phenomena of life, is that the form does not play any part at all in the former, and that therefore "of all problems of physiology, that of form is the least approachable" (O. Warburg, *J. Cancer Research*, **1**, 143; 1925: quoted from V. Cofman, *Chem. Rev.*, December 1928). Without intending at all to participate in any way in the much-debated question as to the ultimate reducibility of life phenomena to those of physics and chemistry, may I point here to certain purely physical cases which, if even not yet entirely realised experimentally, are at least conceivable, and in which the form plays a very essential part.

If we consider physico-chemical systems in the state of equilibrium, the question as to the part played by the form reduces to the following: Does the free energy (or entropy, or any other thermodynamic function, the extremum of which determines the equilibrium) of the system depend on the form of the latter or not? So long as we consider systems with a small specific surface, in which the surface energy is negligible as compared with the volume energy, the answer is negative. Keeping the internal chemical constitution constant, we may alter the form of the system in any arbitrary way without changing its free energy. The form, therefore, is not a characteristic property of such a system.

If, however, we consider systems with large specific surface, in which the surface energy plays a predominant part, the situation changes. Take the trivial case of a homogeneous drop, not subject to gravity. It necessarily assumes a spherical shape, for the smaller the surface area the smaller the free energy of the system, and since the surface area depends on the shape, so does also the free energy. Of course, with the spherical form alone, there is not much done. We must therefore ask: Is the spherical form the only form of equilibrium for a free liquid system with large specific surface, and not subjected to gravity? In this connexion it may be of interest to mention (cf. my paper in *Zeitschrift für Physik*, **51**, 571; 1928) that if we consider a small droplet of any liquid, in which are dissolved several capillary active substances, we must consider such a droplet as consisting of *two* phases; one volume phase, and one 'monomolecular' two-dimensional surface phase, formed by the adsorbtion of the capillary active substances. In the general case, when the two phases may interact reversibly, it may be shown that, for a given volume V of the droplet, the total free energy of the system has a minimum for a certain definite area S_0 of the surface, which may happen to be larger than the area of surface of a sphere of the same volume ($\sqrt[3]{36\pi V^2}$). The droplet in this case assumes *any arbitary shape*, within certain limits, for then there is an infinite number of shapes, for which a body of a given volume has a prescribed surface area. The remark "within certain limits" is important. If, for example, the surface area corresponding to the equilibrium is only slightly larger than the surface area of a sphere of the same volume, then the system, though not being spherical, cannot assume, say, a form of an uniform thin long thread, for this would make S_0 too large (cf. my paper on "Systems with Large Specific Surface" in *Zeitschrift für Physik*, **53**, 107; 1929).

The most interesting cases, however, where the equilibrium of a liquid system is associated with a *definite* form, are found in investigating the possibility of interaction of such a droplet with the surrounding medium. Imagine the interior of the droplet to be the seat of chemical reactions, which result in the formation of the substances, of which the drop consists from those substances which are dissolved in the surrounding medium. These latter, assuming their solubility in the main substance of the droplet, will in these circumstances diffuse from outside into the drop, and will be 'absorbed' there, due to the chemical transformations. If the increase of the total mass of the droplet is very slow, we have the case of a quasi-stationary diffusion process, in which the amount of substances diffusing into the droplet approximately equals the amount absorbed. There is in this case a concentration gradient of these substances from the periphery to the interior of the droplet, and the distribution of the concentrations depends on the instantaneous form of the droplet. The concentration of the dissolved substances will vary along the surface of the droplet, and since the surface tension is a function of the concentrations of the dissolved substances, the surface tension will also vary along the surface. But it is possible that for a certain form of the droplet the distribution of the concentrations along the surface will be such that for all points of the surface the product of the surface tension with the mean curvature of the surface will have the same value. The corresponding form, which is itself determined by the functional relation between surface tension and concentration, and may vary widely from case to case, will be a form of equilibrium and will be automatically restored, if disturbed by a temporary external cause. The details of the mathematical treatment will appear in *Zeitschrift für Physik*.

N. RASHEVSKY.
Research Department,
Westinghouse Electric and Manufacturing Co.,
East Pittsburgh, Pa.,
May 14.

The Mobility of Ions in Gases.

IN a recent paper (*Phil. Mag.*, **6**, 210; July 1928) I described a new method of determining the mobility of ions in gases, the principle employed being the same as that originated by Fizeau for the determination of the velocity of light. It is the purpose of the present note to describe an improvement in the previous method, giving a marked increase in both resolving power and absolute accuracy. This is obtained by the introduction of a new type of grid for producing the periodic 'shutter effect' of Fizeau.

An account of preliminary experiments with the new type of grid, which may be called a deflection grid, was given by me in a D.Phil. thesis in May 1928. In the abstract of this thesis (Abstracts of Dissertations, vol. 1, p. 126; Clarendon Press, Oxford, 1928) the work on the new type of grid was referred to. Recently the same type of grid has been described independently by Cravath (*Phys. Rev.*, **33**, 605; April 1929), who used it for a purpose other than the determination of mobilities.

The deflection grid consists of a series of closely spaced parallel bars or wires lying in the same plane. Alternate bars are connected to one outside electrode, and the remaining bars are likewise connected to a second outside electrode. Thus a slight potential difference between these two electrodes stops the passage through the grid of ions or electrons in the gas by deflecting them to the bars, whereas with no potential difference the grid is identical with one of the usual type.

A typical peak obtained by this method of mobility determination is given in Fig. 1, which shows the electrometer current as a function of the time elapsing

tween the momentary 'opening' of the first grid shutter) and the momentary 'opening' of the ond grid. As the periodic change of potential oss the deflection grids was effected by a com-ıtator of known speed and dimensions, a curve owing the theoretical resolving power may be easily nstructed. This theoretical curve is shown dotted Fig. 1. The close approximation of the experi-ental to the theoretical curve shows that the method s in practice a high resolving power, and also that,

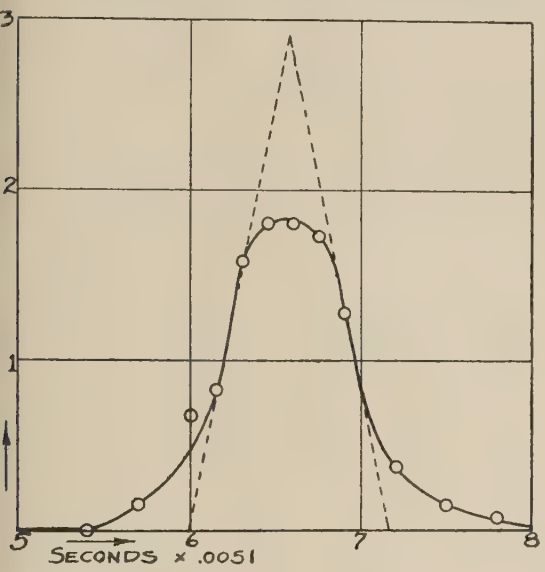

FIG. 1.

least within narrow limits, all the ions had the me mobility, which is 1·84 cm. per sec. as computed m the curve. The experiments were carried out moist air at atmospheric pressure, and the initial isation was obtained by the action of ultra-violet ht on a zinc plate.

Grids for these experiments may be conveniently nstructed by first grinding a series of parallel slots a thin glass plate, then completely silvering the face of the glass, and finally scraping off the silver ere insulation is desired.

R. J. VAN DE GRAAFF
(U.S. National Research Fellow).
The Electrical Laboratory,
Oxford.

Influence of Temperature on Raman Lines.

IN a letter to NATURE of Oct. 27, 1928, on the luence of temperature on the modified lines in ttered light, Dr. Krishnan reported that with ng temperature the intensity of the anti-Stokes es was increased relative to that of the Stokes lines, ng carbon tetrachloride as the scattering sub-nce. I have examined also the influence of tem-rature on certain organic liquids and have observed effect of another kind. When the temperature of scattering substance is increased, certain Raman es become very diffuse. Fig. 1 shows the Raman ctrum scattered by toluene at 10° C. and at 100° C., light source being a mercury lamp. Nearly all lines which appear in this figure are modified from strong Hg line, 4359, except 4617·89 and 4589·2, ich are modified from the Hg line 4047. Among m it can be seen that the doublet lines $\lambda = 4686{\cdot}82$ 4683·33 ($\Delta\nu$ from 4359 being 1607·2 cm.$^{-1}$ and 1·7 cm.$^{-1}$ respectively) become very diffuse at the high temperature. Fig. 2 shows the photomicrometric curve of that spectrum, in which noticeably affected lines are indicated by arrows. The same effect is observed in the scattering by other substances for example, benzene and carbon tetrachloride.

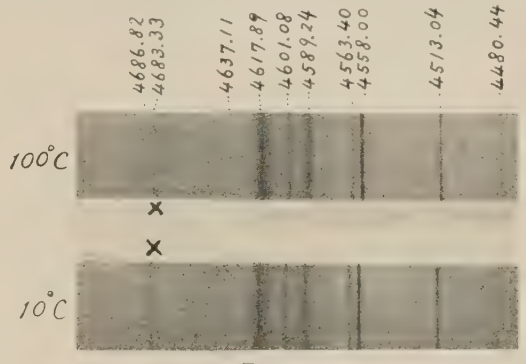

FIG. 1.

Since this broadening of the lines is not common to every line, it does not seem natural to attribute it to the Doppler effect. At all temperatures it is easily noticed with fairly large dispersion that the Raman lines caused by organic substances have several types of structure, that is, very sharp, symmetrically diffuse, asymmetrically diffuse, etc. Also, the broadening effect of temperature is, generally speaking, more noticeable on diffuse lines than on sharp lines. From these facts it does not seem unnatural to suppose that the diffuseness of Raman lines

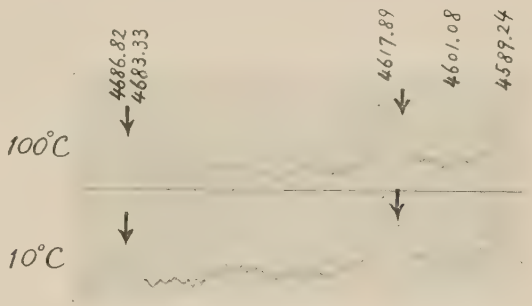

FIG. 2.

is due to molecular rotation and that the increase of temperature accelerates the rotation and causes the broadening of the lines. Further, it is interesting to notice here that in the Raman spectrum of organic substances there very often appear close doublets, and that the influence of temperature is most noticeable upon them. The above-mentioned toluene lines are one example; the doublet in benzene, 4687·10 and 4681·93 ($\Delta\nu = 1680{\cdot}9$ and 1584·4), is another example.

Y. FUJIOKA.
The Institute of Physical and
Chemical Research,
Hongō, Tokyo, April 15.

Sunspots and Pressure.

IN Bombay (Colaba) magnetic data, 1846–1905, Part II. (page 751), Dr. N. A. F. Moos shows that if the annual means of atmospheric pressure at Bombay are smoothed by taking overlapping means of 11 successive years, and if the smoothed 11-year means are placed at the proper epoch, the resulting variation appears to be subject to some slow period secular

change which runs fairly concurrently with that noted in the magnetic and solar curves similarly treated. I was Dr. Moos's assistant at Bombay in 1910 when the volumes were published. As time permitted I tried the 11-year smoothing process on other stations and found correlation coefficients of the smoothed means with similar smoothed means of sunspots. The stations selected, the values of the correlation coefficients, and the number of years made use of, are given in the following table :

	Tokyo.	Batavia.	Port Darwin.	Calcutta.	Madras.	Bombay.	Eniseisk.	Greenwich.	Abbassia (Cairo).	Cape Town.	Mauritius.	Charleston.	Santiago.	Cordoba.	Buenos Aires.
Correlation coefficient .	−0·65	−0·59	−0·61	−0·61	−0·27	−0·37	+0·03	−0·23	−0·61	−0·63	+0·14	+0·10	+0·32	+0·50	+0·73
No. of years . . .	47	55	43	55	55	55	50	55	52	55	50	52	55	52	55

At 6 out of the 15 stations selected the values of the correlation coefficients exceed 0·6, and the positive relationship at the South American stations is significant.

In *Indian Meteorological Memoirs*, Vol. 21, Part XII, published in 1915, on sunspots and pressure, by Sir Gilbert Walker, correlation coefficients between the annual means of sunspots and pressure are given for some 90 stations over the globe. There are only

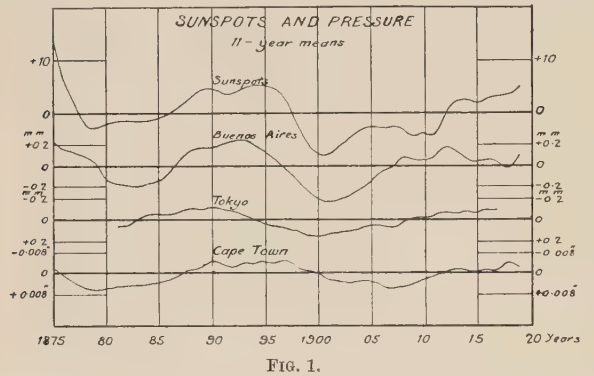

FIG. 1.

three values rising above 0·4, in two of which the number of years is only 20 or 22. The largest value, −0·47, is for Cape Town record for 55 years.

It is probable that irregularities due to various causes mask the relationship from year to year, and the 11-year smoothing process may be fruitful in leading one to the true nature of the relationship.

Curves for sunspots and for pressure at three significant stations are charted in the accompanying diagram (Fig. 1) for exhibiting the parallelism. The period embraces 5 sunspot cycles. The amplitude of the pressure range is about 0·4 mm.

M. V. UNAKAR.

Meteorological Office, Poona,
May 17.

Properties of the He_2 Rotation Terms.

THE analysis of the band spectrum of helium is now nearly complete. The great majority of the stronger lines have been allocated to bands, of which some sixty have now been recognised. The remaining lines may be attributed to (1) higher members of the electronic sequences already known, (2) electronic levels of a new type, and (3) vibrational levels.

In connexion with (1) a special difficulty arises, apart from the relative faintness of the lines, in that most of the bands suffer very considerable changes as the principal electronic quantum number, n, increases. Not only may the appearance of a branch entirely change (from R to Q, say), but it may fade out entirely. In some cases a band which has all three branches present for $n=3$ is reduced to a single branch (R, but of P-form) when $n=6$. The usual method of procedure, by searching for combination relationships, is then impossible, and the correctness of the interpretation proposed must remain in doubt.

The difficulty can be surmounted, in this spectrum at least, by consideration of certain regularities which are exhibited by the rotation term differences of the various electronic states. These are briefly as follows :

(1) With increasing n the differences tend to reach constant values, which in many cases may be estimated to within about 1 cm.$^{-1}$.

(2) These limiting values are identical, not only for all the terms in one system, but also for both singlet (par) and triplet (ortho) systems. They are approximately

	71	127	183	239	294	347	399	450 cm.$^{-1}$
for $(j-\rho)=$	2	4	6	8	10	12	14	16

These are evidently the rotation term differences of the He_2^+ ion, and correspond to odd values of $(j-\rho)$, the even values being missing, in agreement with theory.

(3) The ρ values associated with each electronic state follow at once from the above data, and agree throughout with those proposed by Dieke (NATURE, vol. 123, p. 716, 1929), except that for his p_b states $\rho=+1$ instead of -1 as given in his table.

It is unnecessary to give here a full description of the regularities found, but they are such that most of the rotation terms at present missing can be predicted within a few cm.$^{-1}$; conversely, the interpretation of new bands is greatly facilitated. Thus, for example, two new branches of P- and Q-form recently found by Dieke, Takamine, and Imanishi (*Zeitschr. f. Phys.*, **54**, 826 ; 1929), but not identified, are easily recognisable by this method as Q and R branches of the $6X$ level of ortho-He_2. Even single branches may now be interpreted, provided that the final electronic state is known, since it is possible to derive a set of initial term differences by combining the known final term differences with the intervals between successive lines in the branch. These differences, if genuine, will fit into the scheme and their designation will be apparent.

It is clear that this method will be of very great assistance in resolving the last complexities of the He_2 spectrum. It will be interesting to see whether it is applicable to other band spectra, and in particular to that of hydrogen.

W. E. CURTIS.
A. HARVEY.

Armstrong College,
Newcastle-upon-Tyne,
May 31.

The Heterodyne Null Method of Measuring Dielectric Constant.

It is found that different investigators using the ne heterodyne null method differ widely in their ults for the same substance. This is indicated m the results of different investigators in the cases carbon dioxide, hydrogen sulphide, and methyl oride. In a recent paper (*Phys. Rev.*, **32**; 1928) an has tried to find out the sources of this discrep-ey, and suggests that besides the calibration errors re are other possible sources of error in the method. om the data of Watson (*Proc. Roy. Soc.*, **117**; 1927), an attributes one of these to the difference in quency of the oscillating circuits which the various estigators have used. But this cannot produce a ge effect on the results. We wish to point out the ssible sources of error from our own experience for last couple of years with the apparatus we are ng for measurements of dielectric constant. They as follows :

1) The method of measuring temperature by ding the platinum wire on the glass tube con-ning the experimental condenser or on the con-ser itself (when a cylindrical condenser is used) h proper insulation, may probably produce a large or owing to the presence of this stray capacity r the experimental condenser if proper care is not en to eliminate this effect. Even if the bath which tains the experimental condenser is well earthed, l this stray capacity affects the results, and proper e should be taken to connect the experimental denser in the case of a cylindrical one. This effect been carefully studied by Sarkar (*Ind. Jour. Phys.*, 1928). He found that when the inner cylinder the experimental condenser was connected to the de of the thermionic tube it gave more concordant lts than when the outer cylinder was connected. the latter case even the movement of any other ductor or variation of current in any other circuit nected to the mains in the room would change pitch of the beat note, whereas no such difficulty observed in the former case.

Hence the method of measuring the temperature the thermo-couple is preferable. It is also found t when the thermo-couple is put into the bath frequency of the oscillating circuit changes. It herefore advisable not to put the thermo-couple the bath at the time of taking observations, and temperature should be measured just before and r the observations are taken.

2) If the bath be heated electrically from the ns, it is found that there is a difference of pitch en there is no current passing through the heating and when there is a current passing. This dently indicates a presence of stray capacity and uction effect. To avoid this, it is better to dis-nect the heating coil of the bath from the main en the measurement is to be taken.

Taking all these precautions we have found that value of the dielectric constant for dry and bon dioxide free air at N.T.P., is $1{\cdot}000579_{\pm 4}$.

P. N. GHOSH.
P. C. MAHANTI.
University College of Science and Technology,
Calcutta.

The Swelling of Rubber.

SOME recent experiments on the diminution of the our pressure of solvents in rubber jellies as well measurements of swelling pressure allow us to draw e conclusions as to the nature of the swelling nomenon.

t has been found that, at the same concentration of rubber, the vapour pressure of rubber jellies from rubber of *different* origin was the same, and previous mechanical working (mastication) of rubber had also no effect on this value (P. Stamberger, *Rec. Trav. Chim. Pays-Bas.*, **47**, 316; 1928). After the mechanical working, however, the rubber swells in an unlimited manner and gives as a resulting product up to a concentration of 30 per cent a more or less viscous liquid. This behaviour shows that the solvent is not bound by surface adsorption and that there is a great resemblance to the process of molecular disperse solution. The three solvents used for these determinations were: carbon disulphide, chloroform, and benzene. The *same relative vapour pressure diminution* was found when the concentration has been calculated as grams of rubber in 1 gm. mol. solvent.

The shape of the curve in which the relative vapour pressure was plotted against the concentration differs from that expected according to Raoult's laws. The curves bend rapidly at a concentration of 20-30 per cent towards the vapour pressure axis. Although some resemblance to the ordinary process of solution was found, this behaviour suggests a process of a more complicated nature. But the affinity of the solvent for the rubber can only be due to molecular forces.

Although no difference has been found between the vapour pressure of the 'liquid' jelly of masticated rubber and the solid elastic jelly of untreated rubber, the swelling pressure of both showed *big differences*.

The liquid, masticated rubber jelly had a swelling pressure of 35 cm. of mercury at a concentration of 0·4 gm. rubber in 1 c.c. of solvent (toluene), the unmasticated had the same swelling pressure at a much lower concentration, 0·11 gm./c.c.

This value shows that the swelling of a structureless (masticated) rubber differs greatly from the swelling of a rubber having a definite structure, although both show the same vapour pressure diminution. For this reason it is not possible to calculate the swelling pressure from the vapour pressure diminution on a simple thermodynamic basis.

This behaviour shows that the forces which cause the imbibition of solvent by the jelly are not of a uniform nature and the 'structure factor' has an influence when the solvent is present in a liquid form (P. Stamberger, loc. cit.).

Particulars of this investigation will be published shortly.

P. STAMBERGER.
C. M. BLOW.
University College, London,
June 4.

The Isotopes of Oxygen.

I HAVE recently been studying the vibrational energy functions of molecules, in connexion with a recalculation of heats of dissociation, and have noticed that the equation given by Dieke and Babcock (*Proc. Nat. Acad. Sci.*, **13**, 670; 1927) for the upper level of the atmospheric bands of oxygen has an unusually large coefficient for the n^3 term. This, I now find, is due to an arithmetical error of 2 cm.$^{-1}$ in their location of the origin of the $O - O$ band. The correct figure should be 13,120·97 cm.$^{-1}$, instead of their 13,122·97. The correction not only leads to the expected small coefficient for n^3, but also brings their data into good agreement with the older constants, as given on p. 232 of the "Report on Molecular Spectra in Gases". The resulting corrected equation is

$$E_n = 13{,}120{\cdot}97 + 1418{\cdot}69n - 13{\cdot}925n^2 - 0{\cdot}02n^3 \quad (n = 0,\ 1,\ 2,\ 3),$$

as contrasted with their

$$E_n = 13{,}122{\cdot}965 + 1415{\cdot}017n - 11{\cdot}911n^2 - 0{\cdot}3525n^3$$

The new constants are of importance in connexion with the isotopes of oxygen. Giauque and Johnston

(NATURE, Mar. 2, 1929) found that the assumption of $O^{16} - O^{18}$ and $O^{16} - O^{16}$ as the two molecules concerned, led to a calculated isotope splitting, in the $O - O$ band, which averaged 0·05 cm.$^{-1}$ greater than the observed splitting. (From their original data I find that the average is 0·053 cm.$^{-1}$, for the 25 lines used.) The change in the vibrational constants just given lowers the calculated splitting by just 0·067 cm.$^{-1}$, making the discrepancy now only 0·014 cm.$^{-1}$ in the opposite direction.

More recently, Giauque and Johnston (NATURE, June 1, 1929) have interpreted faint lines in the $O - O$ band, newly found by H. D. Babcock (*Proc. Nat. Acad. Sci.*, in press), as due to an $O^{16} - O^{17}$ molecule. The calculated isotope splitting is again too large, in this case by an average of 0·03 cm.$^{-1}$, although the faintness of the new lines makes the probable error much larger than in the previous case. The change in vibrational constants lowers the calculated splitting 0·036 cm.$^{-1}$, and so practically cancels the discrepancy. One can accordingly conclude that there is now perfect agreement with the theory, on the basis of 16, 17, and 18 for the atomic weights, and half-integers (on the *old* quantum theory) for the vibrational quantum numbers.

Babcock's measurements of relative intensity (NATURE, May 18, 1929) indicate that O^{16} has an abundance at least 1250 times that of O^{18} (see Giauque and Johnston, NATURE, June 1, 1929). The O^{17} atom, according to Babcock's work, is much less abundant than O^{18}. On the basis of these figures, Aston's determinations of atomic weights, made with his mass spectrograph, should be not more than one part in 10,000 greater than the chemical values.

RAYMOND T. BIRGE.

University of California, June 1.

An Intermetallic Compound having a Simple Cubic Lattice.

ANTIMONY tin alloys [1] containing 43, 50, and 55 per cent of antimony were annealed respectively at temperatures of 240°, 270°, 290°, in a closed glass tube for 200 hours, then slowly cooled to 240° and kept

FIG. 1.

25 hours at this temperature, and by slow cooling brought to room temperature. These samples showed the X-ray spectrum lines belonging to a simple cubic lattice, as shown in the accompanying photogram (Fig. 1). The table below indicates the result of the X-ray analysis.

FILM-DIAMETER = 5·525 CM., RADIATION FROM IRON.

Indices.	43 per Cent Antimony (Rod).		55 per Cent Antimony (Rod).		50 per Cent Antimony (Powder).	
	Reflected Angle.	Lattice Constant.	Reflected Angle.	Lattice Constant.	Reflected Angle.	Lattice Constant.
(100)	18·29°	3·052 A.	18·40°	3·065 A.	18·39°	3·068 A.
(110)	26·67	3·049	26·65	3·051	26·50	3·066
(111)	33·34	3·050	33·34	3·050	33·12	2·067
(200)	39·39	3·050	39·39	3·050	39·31	3·054
(210)	45·16	3·051	45·11	3·053	44·91	3·064
(220)	63·69	3·053	63·46	3·059	63·69	3·053
{221} {300}	71·86	3·054	71·89	3·054	71·95	3·053
	Mean . 3·052 A.		Mean . 3·054 A.		Mean . 3·061 A.	

[1] The equilibrium diagram of this system studied by Prof. K. Iwasé and N. Aoki will appear in *Science Reports* of Tôhoku Imperial University, Sendai.

The densities observed for 43, 50, and 55 per cent antimony are respectively 6·9084, 6·9100, 6·9109. The number of atoms contained in a unit cell is calculated to be 0·9918, 0·9993, and 0·9908, being very nearly equal to 1. This fact and the spectral indices confirm that the crystal structure of these alloys is a simple cubic lattice. From the result of the X-ray analysis it is concluded that the range lying between 43 and 55 per cent of antimony is a solid solution of this compound and one of the components. It is only very rarely that a metallic compound has a simple cubic lattice. ATOMI ÔSAWA.

Imperial University, Sendai.

Heterogonic Growth in the Appendages of Crustacea.

PROF. J. S. HUXLEY and Miss Tazelaar find (NATURE June 15, p. 910) that the appendages behind the enlarged male chela in *Inachus* and *Palæmon carcinus* show a slight acceleration of growth, while those anterior to it show a slight retardation. They express this as "an influence on the growth gradient by the axial relations of the whole animal". I presume that this is merely a way of expressing a purely empirical correlation, and therefore I do not understand what is meant by suggestions bearing on the mechanism of this influence. What is the mechanism of the influence which produces the original heterogonic growth centre near the tip of the large chela ?

Empirically the heterogonic growth of the large chela is correlated with greater muscular activity on the part of this chela in the male as compared with the female. It seems to me the important question is whether the acceleration of growth in appendages posterior to the chela is correlated with greater activity of those appendages as compared with those anterior to the chela. As for 'mechanism', it is generally agreed that the heterogonic growth in the individual crustacean is due to some endocrine effect associated with the male gonad or with the sex-chromosomes. Surely whatever the mechanism may be which causes the heterogonic growth of the large chela, that of the appendages posterior to it is due to the same mechanism. I see no reason for assuming that the accelerated growth of the latter is a secondary effect of that of the large chela.

J. T. CUNNINGHAM.

35 Wavendon Avenue, W.4.

Hermaphrodite Oysters.

THE interesting question of hermaphrodite oysters was raised in NATURE of June 8 by Mr. I. Amemiya.

On this subject it is appropriate to make the following remarks :

1. In 1854, Lacaze-Duthiers (*Ann. Sci. nat. Zool.* ser. 4, ii., p. 217) pointed out the hermaphroditism of the small *Ostrea stentina* Payr., synonymous with *O. plicatula* Gmel. and *O. plicata* Chemn., for malacologists generally.

2. In 1911 an undeterminable *Ostrea* (*O. sp.*) from Saleh Bay (Sumbawa) was quoted as hermaphroditic ("Siboga Expedit.", Part 53 *a*, pp. 27 and 102).

3. In 1926, Gutsel (*Science*, **44**, p. 450) described the hermaphroditism of *Ostrea equestris*.

4. With *O. edulis*, *O. angasi*, *O. lurida* and *O. densela mellosa*, there are, so far, only seven hermaphroditic species in the great genus *Ostrea*, or a very small number in comparison with the dioïc forms in the same genus. The latter are very numerous indeed, namely, all the species of the 'subgenera' *Alectryonia* and *Gryphæa*, and also some others which are not related to these two groups. PAUL PELSENEER.

The Distribution of the Chemical Elements.[1]

By Dr. V. M. Goldschmidt, Professor of Mineralogy, Oslo.

)ETROLOGISTS generally agree that the earth contains a core of an iron alloy, most probably ckel iron with about 8 per cent of nickel, in analogy the most common types of iron meteorites. Below e common silicate rocks of the crust there is obably a region of enrichment of heavier sili-tes, which have separated by crystallisation from olten silicate magma, and have settled downward ving to their high specific gravity. Probably the ineral olivine is present here in substantially rger amounts than in the average surface rocks. does not explain the fact that there seems to be a very distinct boundary to the iron core, and also a marked discontinuity against the silicate mantle. It seems also improbable that two substances of so different density as iron and silicate, originally present in a molten state, would not have separated in the earth's field of gravity. The possibility must be considered that this intermediate shell largely, or at least to a considerable part, contains sulphides and oxides of heavy metals, especially the mono-sulphide of iron, a substance we even observe as a

Radial Thickness.	Density.	Name.	Main Chemical Features.	Main Physical Features.	Which Group of Elements is Concentrated.
Several 100 km.	0-0·0015	Atmosphere	Nitrogen, oxygen, water vapour, carbon dioxide, rare gases	Gas	Atmophile
0-11 km.	about 1	Biosphere	Organic substances and skeleton minerals	Solid and liquid, often in colloidal division	Biophile
0-11 km.	1	Hydrosphere	Oceanic and fresh water with dissolved salts and gases, snow and ice	Liquid (in part solid)	Atmophile (and some lithophile)
30-120 km.	2·8	Earth's crust of silicates	Ordinary silicate rocks	Solid	Lithophile (of late crystallisations and mother liquors)
1100 km.	3·6-4	Eclogite shell	Silicate rocks, probably rich in Mg_2SiO_4	Solid, very dense crystalline arrangements of atoms (eclogite facies)	Lithophile (of early crystallisations)
1700 km.	5-6	Sulphide - oxide shell	Characterised by large amounts of sulphides and oxides of heavy metals, especially iron	Solid	Chalkophile
3500 km.	8-10	Nickel iron core	Alloy of iron and nickel	Solid (in part liquid ?)	Siderophile

ncerning the physical state of matter in this avier silicate shell underlying the earth's crust, know with certainty that it is in the solid state, d that certain crystallised silicates and other nerals must be present in a peculiar state of high nsity owing to pressure, which is characteristic the eclogite facies, as deduced by Fermor and kola, and recently most convincingly demon-ated by P. Wagner.

Between the eclogite shell and the iron core there still another mighty shell, separated from the ogite shell and from the iron core by surfaces discontinuity detected by measurements of the pagation of seismic waves. By many petro-ists this shell is considered to be a mixture of cate and nickel iron. This opinion, however, distinct separate phase in a very large number of meteorites.

From many basic igneous rocks in the earth's crust molten sulphides segregate as separate sul-phide magmas. Any such sulphide magma will tend to migrate towards the zone between the iron core and the silicate mantle, so that in this region of the interior of the earth there would accumulate the major part of sulphidic compounds, mainly iron monosulphide, together with heavy oxidic minerals, especially oxides of iron and chromium, which separate from silicate magmas at early stages of crystallisation.

Outside the silicate shell or lithosphere, there are further envelopes of our earth, the hydro-sphere and the atmosphere, and on the boundary between the lithosphere and atmosphere, as well as intergrown through the hydrosphere, there is a

[1] From a discourse delivered at the Royal Institution on Friday, 15.

last, and from the human point of view a most important sphere, the biosphere, the zone of organised organic substance, the zone of life.

Our earth thus is separated into a number of shells, arranged in the order of density, as shown by the table on p. 15.

Men of science agree that our solid earth must once have been in a molten condition to enable the density distribution which prevails to-day to be formed. Already in times older than geological record, in the early 'astronomical' age of the earth, the subdivision of the molten planet, surrounded by a gaseous envelope, into several liquids, must have begun, followed by separation of the different liquid phases according to gravity. The distribution of chemical elements between the three liquids and one gaseous phase may now be considered from the viewpoint of physical chemistry; we may try to find the quotients of partition in the four-phase equilibrium. Such volatile elements, which have no very great affinity to the substances of the three liquid phases, will accumulate in the gaseous envelope, such as, for example, argon and nitrogen; also compounds with similar properties, as water and carbonic acid, will enter the primordial atmosphere. All these substances may be called *atmophile*. Many chemical elements gather in the silicate magma; they are *lithophile* elements. The most prominent element is oxygen, constituting 62 per cent of the numbers of atoms present, or even 92 per cent of the volume of the earth's crust. The only heavy metal entering in appreciable amounts into the silicate shell is iron, about 2 atomic per cent of iron being present.

Next we shall consider the elements which are concentrated in the molten iron; we may call them *siderophile* elements. These are elements having a great solubility in molten iron, either as uncombined elements or as chemical compounds, such as nickel, platinum, carbon, phosphorus. Lastly, we may consider the elements which enter into molten iron sulphide; we may give them the name *chalcophile* elements. Such elements are, for example, copper, silver, lead, bismuth, selenium.

The actual amount of metals and of non-metallic elements in the earth as a whole has resulted in sulphuration and oxidation of part of the iron. We find iron in large amounts in the sulphide phase, and even to some extent in the silicate phase. Therefore, the partition of all other metals will be dependent on their affinities to oxygen and to sulphur, compared with those of iron. If an element is more siderophile than iron it will enter into the nickel-iron core; if it is more chalcophile than iron it will concentrate in the sulphide phase; if its inclination to enter into oxygen compounds is greater than that of iron it will accumulate in the silicate slag. Iron, therefore, is a kind of measure of geochemical affinity.

It would be interesting to know whether the rarity of precious metals is real, or if it is due to special quotients of partition which might have concentrated such metals as gold and the platinum metals, in the interior of our planet. Especially it would be a matter of importance to ascertain if the elements of the platinum group really are so very rare as they appear to be from most analysis of terrestrial matter. The average amount of platinum in the average silicate rocks may be considered to be of the order of 1 to 1000 millions, that is, about 1 gram in 1000 tons of rock. We may, without any doubt, predict that platinum and the other siderophile metals of the platinum group must be found in very much larger concentrations in iron meteorites, if the present distribution of elements is due to an equilibrium of partition. By the microdocimastic methods of analysis, worked out for our geochemical work by Dr. Lunde and Mrs. Johnson Høst, a large number of terrestrial rocks and of meteorites were analysed for precious metals by Mrs. Høst in my laboratory. Some data from her determinations illustrate the amount of platinum metals in meteorites:

Iron Meteorites.	Total Platinum Metals.
Arispe	117 grams per ton.
Savik, Cape York	75
Mount Joy	68
	54
Mukerop	38
Toluca	25
N'Goureyma	2
	2

Silicate Meteorites.

Juvinas	No platinum metals, no silver, no gold. Total precious metals less than 0·05 gm. per ton.
Stannern	No platinum metals, no silver, no gold. Total precious metals less than 0·05 gm. per ton.

These data, and many others, demonstrate that the platinum metals are not to be considered as very rare elements, but that their relative rarity in terrestrial surface rocks is only a consequence of their partition between nickel iron and silicates.

The quotients of partition between the different phases for any given element must be dependent on the properties of this element, and we may expect to find general relations between geochemical distribution and the properties of atoms and ions. If we plot a diagram showing the atomic volume of the chemical elements as a function of atomic number (nuclear charge), we find the following correlation between geochemical character and atomic volume. The typical siderophile elements are found at the minima of atomic volume, as, for example, carbon, phosphorus, iron, ruthenium, platinum. The typical atmophile elements tend towards the maxima of atomic volume, such as hydrogen and the rare gases. Lithophile elements occupy the descending branches, where we find the typical ion-forming elements such as magnesium and calcium. In the ascending branches of the curve we find the typical chalcophile elements, for example, copper and selenium. These regularities seem to be connected with different types of electronic arrangement in the several types of atoms and ions. If there exist elements following after uranium in atomic number, they are probably siderophile, and for this reason they may be absent or nearly absent from the rocks of the earth's crust.

We have seen how the present distribution and

pparent frequency of chemical elements may be rgely due to the laws of partition between the ur phases, a separation which has taken place the very early history of our earth. As cooling roceeds there comes into action a new kind of paration, which has no precedents in the earlier istory of our earth, namely, *fractional crystallisation*. Among the first products of separation are inerals with low solubility in the silicate magma nd high melting points, such as chromite and livine; then follow other iron ores, together with he bulk of pyroxenes and plagioclase felspars; ter on the pyroxenes are succeeded by amphiboles nd biotite; and the basic plagioclases are followed by acid ones and by potash felspar, with uartz and muscovite. At last only pegmatitic agmas and aqueous solutions remain as a kind f mother liquor of the magma, from which rystallise coarse pegmatitic dikes and hydrothermal mineral veins, and from which also gaseous onstituents may escape, giving rise to pneumatoytical minerals.

Whilst the partition into atmophile, lithophile, tc., groups had taken place between amorphous hases, as gases and liquids, the process of fractional rystallisation involves the presence of crystalline hases, and the properties of atoms and ions in rystalline arrangements must be of deciding imortance for the fate of the different elements. he distribution of any given element between a quid phase and a coexisting crystalline phase ill depend on isomorphism between the element or its ions) with the components of the crystalline hase. Now isomorphism, as crystallographers have nown for a very long time, is mainly dependent on he volume of the different kinds of atoms or ions, nd the question of partition therefore leads to a elation between atomic and ionic sizes and geohemical distribution. Therefore, from the geohemical point of view, it is most important to get xact determinations of the radii of atoms and ions n crystals. The formation of crystals will effect sieving or sorting of elements, and this process f sieving may determine the fate of any rarer lement present, including both lithophile elements nd the small amounts of siderophile and chalcohile elements which have entered the molten ilicate.

We must also consider the very important case hat the rare element does not enter the crystal, ut is forced to remain in the liquid. In this anner a number of rare elements are concentrated n the mother liquors of magmas. There they remain ntil their concentration reaches the saturation limit f their own crystalline phases; then they are recipitated as minerals of rare elements. This xplains why, in the mother liquors of silicate agmas, the pegmatite magmas, we encounter such wealth of rare elements. If our principle conerning the relation between fractional crystallisaion and the sizes of atoms and ions is sound, we hall expect to find *two very different types* of rare lements in the mother liquors: those which are of *ery small* size compared with current atomic and onic sizes, and those which have *very large* sizes. This is in the very best accordance with mineralogical experience.

The specific gravity of the liquid part of an ordinary silicate magma, which undergoes processes of fractional crystallisation, decreases substantially as crystallisation proceeds, owing to the high density of the earlier minerals and to the increase in volatile components (as water and carbonic acid) in the mother liquor. Residual magmas and associated aqueous solution will thus have a strong tendency to migrate upwards to the uppermost levels of the earth's crust, and heavy minerals of early crystallisation will tend to sink down towards deep levels. Therefore, in the highest levels of the silicate shell we encounter a relative enrichment of those elements that are concentrated in the light granitic rocks and residual solutions of the magmatic sequence. For this reason many of the rare elements, which are typical for pegmatitic associations, are found in comparatively high concentrations in the uppermost levels of the atmosphere.

The fact that chemists have been able to detect not less than 89 out of 92 possible elements is surely due to the circumstance that the processes of distribution, acting in a strong field of gravitation, have been very favourable for accumulating even very rare lithophile elements in considerable amounts near the surface of our earth. Also, the distribution of the radioactive elements, with a marked enrichment of uranium and thorium in the light rocks of very high levels, is in complete accordance with the principles of geochemical distribution.

An investigation of the present distribution of chemical elements, however, cannot be limited to the study of inorganic nature; there is at work one more factor—the youngest in the story of geochemical evolution—that is, the organic world, the *biosphere* of the earth. Living organisms need a number of elements for the construction of protoplasm and auxiliary substances; we may mention carbon, hydrogen, oxygen, phosphorus, sulphur, chlorine, together with small but indispensable amounts of rarer elements such as iodine. Under most varying conditions of life, organisms have shown their ability to concentrate and utilise the different types of necessary substances; they have become one of the important factors regulating the distribution of chemical elements. Especially for such elements which in the original inorganic matter are present only in more modest concentrations, such as phosphorus or iodine, or fixed nitrogen, organic Nature has become a dominating factor of distribution.

We may become conscious of the importance of organic life in geochemistry if we consider that our present atmosphere, containing a large amount of oxygen and only traces of carbon dioxide, may have got these features largely through the action of plant life on the primary atmosphere of our planet. We may particularly refer, in this connexion, to the ever-increasing activity of man in utilising the resources of our earth, thereby greatly altering the distribution of elements within the reach of his power.

The North-East Coast Exhibition at Newcastle-upon-Tyne.

THIS is an exhibition with a purpose ; it is the gallant attempt of a depressed area to help itself. The genesis of the idea was inside the Chamber of Commerce on Newcastle Quayside ; afterwards it was taken up by the Lord Mayor and Corporation ; it has been carried through by the leaders of industry working as citizens in committees under a general council representative of the associated cities. The idea is the quest for business through associated advertisement and salesmanship.

The Exhibition is in a corner of the Town Moor behind the Hancock Natural History Museum and about a mile from the Central Station. It is easily accessible by tram. Turning round for a moment before entering the gates, Armstrong College and its new Mining Department are seen 300 yards away. Just inside the Exhibition turnstiles a kiosk supplies an "Official Guide" (price 3*d*.) with a plan of the main buildings. These include Palaces of Engineering, Industries, and Arts, a Festival Hall for conferences, a Stadium for boy scouts, an Amusements Park, and the sideshows of the evening newspapers. An "Official Catalogue" (price 1*s*.), bought before leaving and studied at home, will save time on a second visit. This contains the names and portraits of the organisers, a list of exhibits, plans, and full indices. It is a very handy volume, indicative of excellent general organisation. A more bulky "Exhibition Year Supplement" of the *Newcastle and Gateshead Chamber of Commerce Journal* (price 2*s*. 6*d*.), is obtainable in the Guildhall on the Quayside. It contains a trade index of industries with illustrated advertisements. It seems valuable for strangers intending to place large orders or inquiring into the industrial environment before choosing sites for new works.

The natural products of the area include not only coal but also whinstone and limestone for roadmaking, freestone for building, grindstones from the millstone grit, lime from both carboniferous and magnesian limestones, magnesia from the latter, fireclay from beneath the coal, brick-clay from nearer the surface, brine from the trias, and ironstone from the oolite. Navigable estuaries admit shipping and encourage shipbuilding, deep river gorges have stimulated the bridge builders, Cleveland iron-stone and Durham coal have made the Middlesboro' iron and steel industry which supplies material for all the engineering works. Tyneside was the birthplace of Stephenson and of the locomotive. More lately the district has been to the front in the production of high tension electric supply in alternators driven by Parsons turbine machinery, and this electric current has been applied to railway traction and through a grid for other industrial purposes.

The greatest engineering triumphs will not fit into exhibitions. The new Tyne Bridge with roadway slung from an arch apparently parabolic is seen when entering Newcastle from the south. The *Mauretania* and its floating dock may be seen at Southampton. The latest colliery improvements are in the collieries and at work. Locomotives and rolling stock are on the railways. Within the Palace of Engineering these greater objects can only be represented by pictures and models ; 30 tons has been the limit, a steam rail coach brought in by the London and North-Eastern Railway Company. A few other exhibits are here named as samples, not as a catalogue.

Sir Howard Grubb, Parsons and Co., show a reflecting telescope of 3-feet aperture intended for the Royal Observatory, Edinburgh. It is designed in accordance with specifications by Prof. R. A. Sampson, and is to be used chiefly for spectroscopic work. The parabolic mirror and auxiliary hyperbolic mirror combine to make an equivalent focal length of 54 feet. The driving circle is clamped to the polar axis by hydraulic pressure. The driving clock has both its own frictional governor and also a control by impulses received every second from an observatory timekeeper.

Messrs. Reyrolle and Co. have specialised on switch-gear for large electric power stations. With voltages of 33,000 the contacts are made and broken under oil and inside earthed metal-clad cases.

Imperial Chemical Industries explain, by means of a cinema hall, what their associated companies are doing at Billingham. Pictures show how the fertilisers make the grass grow in intensive culture paddocks. Specimens of various products are shown, Billingham carbonate of lime, nitro-chalk and imported nitro-phoska, chlorine for water purification, Portland cement, etc.

The Thermal Syndicate is an example of a new industry made possible by electric supply. Its 'vitreosil' or fused silica finds increasing applications due to its high melting point, low coefficient of expansion, transparency to ultra-violet light, non-conduction of electricity and resistance to acid. The size of worm-tubes for condensation has greatly increased. Also for laboratory use is the Pyrex glass made in Sunderland. There are numerous domestic electrical appliances for heating and cooking. The Electric Lamp Manufacturers' Association is advising on the best methods of industrial lighting.

Among recent developments of driving machinery are the Diesel and half-Diesel engines. A new Doxford engine has no closed ends to its cylinders but two pistons both moving outwards. The great production of metal work has been a stimulus to paint, enamel, and anti-fouling compositions. A coke maker is using X-rays to detect unseen impurities. A toffee-making machine, automatic with endless band, attracts attention. But it is not only the toffee and the toffee-making machine that matter. Behind it stands the maker of the toffee-making machine, and the possibility of inventing other machines with continuous output at increasing profits for other industries. Unfortunately, unlike a toffee works, a coal-mine exhausts its product ; it cannot expand indefinitely, it must finance its sinking funds on other principles. This and other

(*Continued on p.* 27.)

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Cosmical Magnetic Phenomena.[1]

By Prof. S. CHAPMAN, F.R.S.

MAGNETISM on a grand scale in the cosmos has been observed only on the sun and earth. The earth's magnetism has been studied more than three centuries; Gilbert's treatise it, published in 1600, was the first book on dern experimental science, and his recognition t the earth is a great magnet preceded Newton's covery of universal gravitation. Solar mag-ism was first detected twenty-one years ago,[2] l all our knowledge of it comes from a single ervatory.

The measurement of the sun's magnetic field is irect. It depends on the influence, called the man effect, which the field exerts on atoms tting or absorbing light. Certain lines in the ar spectrum are split up, or broadened, by an ount which indicates the magnetic intensity at sun's surface. From this it is easy to calculate maximum possible intensity of the sun's mag-ic field near the earth, and to show that it is small to be measured directly.

The sun is intrinsically a typical star, though its netary system is exceptional. It is therefore bably not the only star possessing a magnetic d. The marvellous advances already made in conomical technique give hope that, in time, lar magnetic fields may be detected, but at sent the measurement of even the sun's field is y difficult.

Lunar and Planetary Magnetism.

t is natural to inquire whether the moon and nets have magnetic fields. The moon is not -luminous, and has no absorbing atmosphere, so t indirect detection of its field by means of the man effect is not possible. It is doubtful also ether the Zeeman effect will be measurable on of the planets. Hence, unless we can measure *ctly* the lunar and planetary fields in the earth's ghbourhood, they are likely to remain unknown.[3] v the field-intensity near the earth, due to a ere of radius a at distance d, with average nsity of magnetisation I, is $\frac{4}{3}\pi I(a/d^3)$. This ies as the cube of the angular radius of the ere (a/d), as viewed from the earth. The moon, ch has a much larger angular radius than any net, is therefore the body most likely to exert a surable magnetic force near the earth. A weak ernal field would be difficult to disentangle from the earth's field, if it were uniform and constant, but the moon's field would be neither of these. It would reveal itself in two ways: owing to the varying distance of the moon as it moves in its rather eccentric orbit, there would be a *monthly* magnetic variation, while the earth's rotation in the slightly non-uniform lunar field would produce a lunar *daily* magnetic variation.

Lunar periodicities in the earth's magnetism have been minutely studied; a lunar *daily* magnetic variation does occur, but it is an indirect effect of the tidal action of the moon on the earth's atmosphere. No variation of the type which a lunar magnetic field would produce directly has been found; if the intensity of the field near the earth were so great as 10^{-4} gauss (or 10γ) it would scarcely have escaped notice. This indicates that for the moon the value of I cannot exceed 100; for the earth I is 0·1, and a value for the moon 1000 times as large as this was in any case scarcely to be expected;[4] in other words, the failure to detect the moon's field near the earth was *a priori* likely. The same applies still more strongly to the planets, and though planetary periodicities in the earth's magnetism have been sought for, none has ever been found.

Cosmical magnetic phenomena, as actually observed, are therefore either terrestrial or solar. Their study demands, first of all, accurate, detailed and long-continued measurements. Then the observations must be reduced by systematic analysis to a much smaller ordered body of facts. This process involves great labour, and is still incomplete, even in the case of the earth. Some important features of the phenomena can be readily perceived, but others have been found only by long computations and minute comparisons with related phenomena. The final task is to explain the facts in terms of general physical laws; this has proved very difficult, and most of the problems of cosmical magnetism remain unsolved. Mathematics is essential in the theoretical discussion; the large scale of the phenomena almost always precludes an experimental test of proposed hypotheses; their consequences, which must be compared with observation, can only be calculated.

Terrestrial Magnetism.

While the study of the sun's magnetism is still in its infancy, terrestrial magnetic science has a

[1] Rouse Ball Lecture delivered at Cambridge on May 31.
[2] By Hale at Mount Wilson, California.
[3] There is a faint possibility that they may be detected by their eting influence on streams of charged particles which issue from un and afterwards fall on the earth.

[4] The magnetic intensity at the surface of a sphere is proportional to I, and if I for the moon were 100, the intensity of its field at its poles would be about 800 gauss, or more than ten times the intensity of the sun's magnetic field.

long history. Seamen, clockmakers, explorers and others have gradually accumulated the great store of data that we now possess; these have been charted and analysed by numerous workers, and have provoked a long series of theoretical speculations. During the Middle Ages the directive property of the compass was generally ascribed to an influence proceeding from the heavens, sometimes even from a particular star; but in the year 1600 William Gilbert, of Colchester and St. John's College, Cambridge, showed that the cause is terrestrial. His proof was simple and convincing; he took a spherical piece of loadstone and explored its field by means of small pivoted magnets; they set themselves in relation to the sphere just as compass needles do in relation to the earth, showing the observed distribution of magnetic dip (Fig. 1); hence he inferred that the earth itself is a great magnet. He had the good fortune to be dealing with one of the few physical properties of a large globe like the earth that can be easily illustrated by a small model.

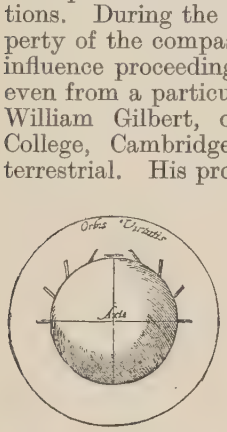


FIG. 1.—Reproduction of a woodcut from Gilbert's "De Magnete" (English translation, 1900).

Subsequent observations have shown that the compass direction can depart more widely from the true north than Gilbert supposed. The earth's field does nearly resemble that of a spherical magnet, but the magnetic axis is inclined at about 12° to the axis of rotation. In addition, the field is

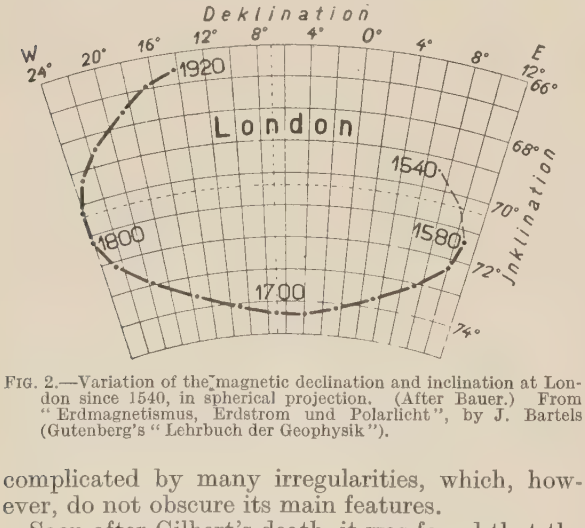


FIG. 2.—Variation of the magnetic declination and inclination at London since 1540, in spherical projection. (After Bauer.) From "Erdmagnetismus, Erdstrom und Polarlicht", by J. Bartels (Gutenberg's "Lehrbuch der Geophysik").

complicated by many irregularities, which, however, do not obscure its main features.

Soon after Gilbert's death, it was found that the earth's field is not constant. The secular change in the *direction* of the magnetic force has been measured at a few places for more than three centuries, but the data for the first two of these are scanty. Measurements of the *intensity* of the field extend over little more than a century. The change in the direction of the force at London since 1540 is shown in Fig. 2; the variation appears to be fairly regular, and possibly periodic; if so, the period is not less than five centuries. It has been supposed that th secular variation largely consists of a rotation of th earth's magnetic axis round its axis of rotation, bu the observations do not warrant this inference (cf Fig. 3). They suggest rather that the secular varia tion, though a large-scale phenomenon, is regiona and not world-wide in character. Its most notabl property is its rapidity: large-scale changes in th state of the earth are in general much slower tha the magnetic variation. The earth's magnetisatio seems to have decreased by about 5 per cent durin the century for which observations of the intensit are available; at present the decrease is proceed

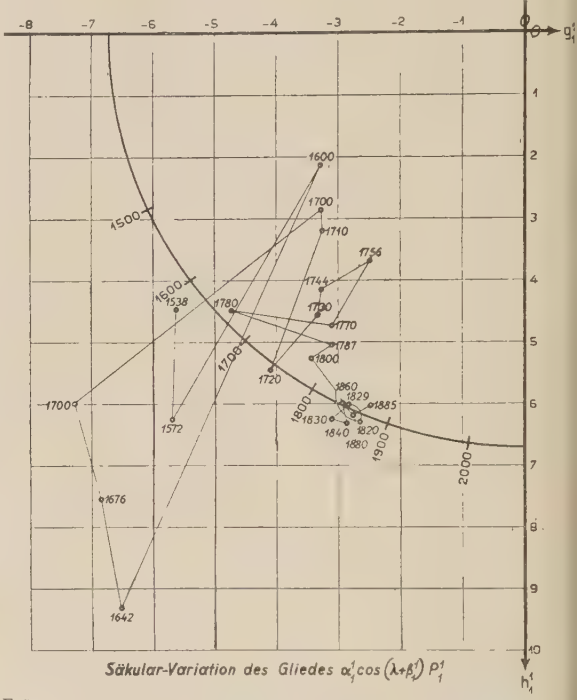


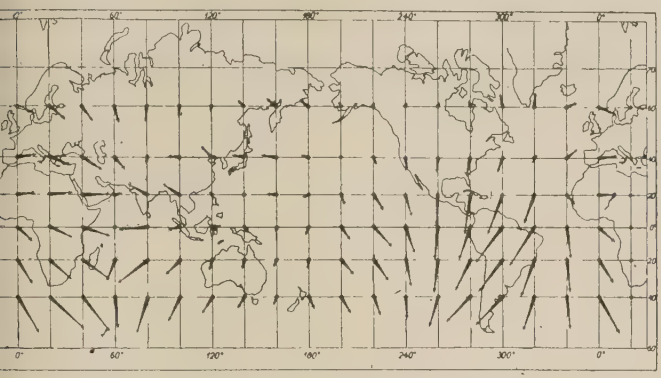
FIG. 3.—Variation, in magnitude and direction, of the transverse com ponent of the earth's magnetism, which mainly determines th obliquity of the magnetic axis. The determinations before 182 are very uncertain, and the subsequent change in direction of th axis is small.

ing most rapidly in the southern hemisphere (cf Fig. 4).

On the basis of our present knowledge, it is im possible to guess the past or predict the futur course of the earth's magnetism. Three centuries i a trivial fraction of the life of the earth, and worker on terrestrial magnetism may envy astronomers whose observations extend over thousands of years Geologists, who have the age-long record of th rocks at their disposal, are still more fortunate There is hope, however, that the rocks may revea also something of the *magnetic* history of the earth

Just before volcanic lava solidifies, it acquire induced magnetism along the direction of the earth' field; afterwards its magnetism is believed to re main constant. Mercanton, of Switzerland, ha determined the direction of magnetisation of lav specimens carefully cut out from deposits, in man parts of the earth, which appear not to have bee tilted or distorted since they were first formed. H

erefore infers the direction of the earth's field, ative to the lava deposits, at remote geological ochs. Large deviations from the existing relative ection of the field are found, the difference some- nes almost amounting to a reversal. Can the rth's magnetism really have changed its sign ring geological time? One is tempted to say



g. 4.—Annual secular variation of horizontal magnetic force at epoch 1922 (after Bartels): scale 200γ per cm. (approximately).

, but the denial is unjustified while we know so le about the cause of the magnetic field. Other erpretations of the evidence may, however, be ssible; though the lava may not have been tilted distorted, it may have moved or turned bodily, a horizontal plane, relative to the field. If the ssibility of such motion can be excluded, or if e motion can be estimated, our knowledge of e earth's magnetic history may be greatly ex- nded.

Gilbert's comparison of the earth with a spherical dstone gave a concise representation of a multi- de of isolated magnetic measurements. It could t establish a physical theory of the earth's gnetism, but it was the first contribution to the ddle, systematic, stage in the development of restrial magnetic science. His demonstration of e internal origin of the field was confirmed and ndered more precise, 240 years later, by Gauss. a memoir which, like Gilbert's treatise, marked epoch in physical science, Gauss applied the eory of the potential, and the method of spherical rmonic analysis, to the earth's magnetism. He owed how from a knowledge of the distribution magnetic force over the earth's surface it is pos- le to determine whether the origin of the field internal or external, or both, and, in the latter se, how to evaluate the two separate parts. th the limited data at his disposal, he was ntent to show that the observations, including ir departures from the field of a spherical mag- , were consistent with an internal origin. Later alyses, with better data, restrict any possible ernal part of the surface field to about 3 per nt of the whole; there may also be a similar all fraction which does not possess a potential, d is therefore due to electric currents *crossing* the face, from earth to air or vice versa: but observa- ns of atmospheric electricity cast doubt on the stence of this part.

The main fact is that the earth's field above its surface is similar to that outside Gilbert's spherical loadstone; the intensity at distance r from the earth's centre varies as $1/r^3$. When r is equal to two earth radii, that is, 4000 miles above the earth's surface, the field is reduced to one-eighth its surface value. Hence it remains appreciable for thousands of miles above the earth. The tubes of force extend throughout, and far beyond, the atmosphere.

Solar Magnetism.

The sun's field is quite different in this respect. It is fortunately possible to measure its intensity at different depths within the solar atmosphere, for the composition varies with depth, and the Zeeman effect can be determined independently from spectral lines due to different atoms at different levels. In this way Hale and his colleagues discovered a rapid decrease of magnetic intensity with increasing height. The measured reduction (from 50 to 10 gauss for the polar intensity) is in the ratio 5 to 1, and extends over a linear distance of only about 50 km., according to Milne's theory of the solar atmosphere. If the sun's field, like the earth's, varied in intensity as $1/r^3$, this 5 to 1 reduction would extend over more than a million kilometres.

The intensity probably diminishes to values still lower than 10 gauss, though these cannot yet be measured on the sun. The rapid radial decrease of the field shows that few or no tubes of magnetic force can pass through the sun's atmosphere into outer space; they must lie nearly horizontally in the atmosphere. The difference between the solar and terrestrial fields is illustrated by the lines of force outside the full circles in Fig. 5.

The sun's field, like the earth's, is nearly symmetrical about an axis, which in the solar case is inclined at about 4° to the axis of rotation. The

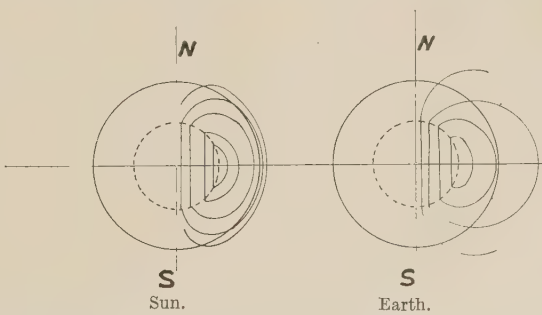


Fig. 5.—Lines of force in the solar and terrestrial magnetic fields: the curves inside the outer circles are merely conjectured.

magnetic polarity of the sun is the same, in relation to its direction of rotation, as for the earth—a fact of great theoretical interest. The earth's field, including its irregularities, rotates at the same speed as the nearly rigid earth, whereas the sun's field and magnetic axis rotate more slowly than the solar surface, the respective periods of rotation being about thirty-one days and twenty-six days.

The polar intensity of the earth's field is about $\frac{2}{3}$ of a gauss, while for the sun it is estimated to be 50 gauss; it may well be still greater lower down in the atmosphere, where the opacity of the gas prevents further observation.

In addition to the *general* field, there are very intense *local* magnetic fields in the sun's atmosphere, associated with sunspots: intensities of 3000 gauss are frequent; there is no corresponding terrestrial magnetic phenomenon. Sunspots commonly occur in pairs of opposite magnetic polarity; the two members of a pair generally lie along a line nearly parallel with the sun's equator. The polarity of the leading spots of pairs in one hemisphere (northern or southern) is the same as that of the following spots in the other hemisphere. The number of sunspots waxes and wanes in an eleven-year cycle: each cycle begins at sunspot minimum with the birth of spots in relatively high latitudes on the sun (about 30°); the spots are not of long continuance; as new spots appear and die away, their average latitude steadily decreases, both throughout the three or four years of increasing spot frequency, and in the subsequent seven or eight years after sunspot maximum, until the next epoch of minimum frequency is attained.

The cycle ends with the occasional appearance of spots near the solar equator; this continues for about a year after the beginning of a new cycle is marked by the recurrence of spots in high latitudes. All through the old cycle the leading spots in both hemispheres have a definite magnetic polarity, with few exceptions. In the new cycle the whole arrangement of polarities is reversed; the leading spots in both hemispheres have the polarity which in the preceding cycle characterised the leading spots in the other hemisphere. The complete cycle of sunspot change therefore extends over twenty-two years, and includes two maxima and two minima of sunspot frequency. A beautiful qualitative theory of this remarkable series of phenomena has been outlined by Bjerknes, and awaits quantitative development.

These are the main known facts regarding the solar and terrestrial magnetic fields, though in addition there are various transient fluctuations of the earth's magnetism, of small magnitude but of considerable theoretical interest.

Origin of the Magnetism of the Earth and Sun.

Many attempts have been made to provide a physical theory of the earth's magnetism, but with no definite success as yet. In Gilbert's time electromagnetism was unknown, and he was confident that the earth consists of magnetised matter, like his loadstones; he attributed the irregularities in the earth's field to the magnetic attraction of the continental and other inequalities of the earth's solid surface. A small, strongly magnetised, fraction of the globe, or a large part magnetised to a low intensity (0·1), would account for the field; but iron and other magnetic substances lose their magnetisability at critical temperatures which are attained at a small depth—20-30 km.—below the surface: there are various magnetic deposits in the layer above this depth, which are responsible for some notable local anomalies in the earth's field, but this layer seems quite insufficient to account for the main field. For a time it was hoped that the increase of pressure accompanying that of temperature as we go downward in the earth might raise the critical temperature, and so enable iron to remain magnetic at deeper levels; but recent experiments at the Geophysical Laboratory of the Carnegie Institution of Washington indicate that pressure has the opposite effect. The earth's magnetism must therefore be ascribed to some other cause, and the same is evidently necessary for the sun, owing to its gaseous state.

The next simplest hypothesis is that the fields are due to ordinary electric currents flowing inside the earth round the magnetic axis. Such internal currents will decay unless maintained by permanent electromotive forces; their free life is proportional to the conductivity and the square of the radius of the body, and for large bodies may be very long. In a globe of copper (at 0° C.) as large as the earth, the currents, as Lamb has shown, would take about 20 million years to decay in the ratio 10 to 1; while if the globe were as large as the sun, the time would be about two hundred thousand million years. I have recently estimated that the electrical conductivity at the centre of the sun is about 3×10^{-4}, half that of copper at ordinary temperatures, and that it decreases to about 10^{-8} just below the photosphere; large-scale electric currents in the sun would therefore die away at a rate imperceptible to us. The electrical conductivity of the earth is likely to be much less than that of copper, or even of iron (about 10^{-4}), at ordinary temperatures, because although iron possibly constitutes an important fraction of the core, its conductivity decreases considerably as the temperature rises; thus if *freely decaying* currents inside the earth are responsible for its magnetic field, their intensity in the remote past must have been immensely greater than now.

It must be left to future ages, by centuries of observation, to determine whether the fields of the sun and earth are decreasing; we cannot safely assume that the present rapid rate of diminution of the earth's field will continue. But there is no apparent reason why causes that could once generate such currents should altogether cease to operate, and the currents, if they exist, may be continuously maintained.

A possible mode of maintenance of internal electric currents has been suggested by Larmor; in the presence of the existing field, the necessary electromotive forces could be induced by an internal circulation having a component of its motion in the meridian planes, symmetrical about the axis and also with respect to the magnetic equator. Such a circulation might not only be able to *maintain* the electric current system and its magnetic fields: it might even build up the field from insignificant beginnings; and there is more than one known way in which the rotation could produce an initial field of very minute

ensity. The internal circulation, if once started, uld decay very slowly, owing, as Lamb has shown, the small influence of viscosity in large bodies; reover, it might be maintained against frictional ardation at the expense of the heat energy of body. In the sun, the motion of the mean nspot zone towards the equator during each ven-year cycle suggests the existence of a culation of the right type; and such a circula- n is invoked in Bjerknes' theory of sunspots, ich, whatever its difficulties, is the only one at has yet shown any capacity to explain remarkable collective properties of sunspots. have applied a rough numerical test to rmor's theory in the case of the sun, and the antities involved seem not unreasonable; there , however, some qualitative difficulties in the ory.

In the case of the earth, the existence of the posed circulation is entirely conjectural, though he underlying strata are slowly flowing equator- rds, and can exert a slight drag on the base of continental masses, it might fit in with and move a difficulty in theories of continental drift. rmor has remarked also that the secular changes the earth's magnetism might be simply accounted merely by change of the conducting channels the internal electric currents. The theory ems to me to have many attractive features, ough until it is further developed, especially on quantitative side, it must be viewed with erve, like other geophysical or astrophysical ories in their first qualitative stages. Edding- n has inferred from a theorem by von Zeipel at some kind of internal circulation must almost tainly arise in a rotating star; if it could be own that the circulation is likely to be of the sent type, Larmor's theory would gain further pport, and would add weight to the conjecture, de many years ago by Schuster and Kelvin, at magnetic polarity is a general property of ge rotating bodies.

A variety of other explanations of solar or ter- trial magnetism have been proposed, involving ation as an essential feature. Those based ely on known facts and established physical ys have all failed to explain more than a minute ction of the observed fields. Even the hypo- ses in which some liberty of speculation has en taken have in most cases involved contra- tions with observed facts of other kinds, which essitate their rejection. Any simple theory ich seeks to account for the observed intensities the fields of the earth and sun in terms of their own density, size, and angular velocity must also consistent with the observed failure of rotation, en at very considerable speeds, to produce gnetisation in non-magnetic bodies of small e in the laboratory; this proves to be a rather ingent limitation.

Among the theories which satisfy this condition l are based on some hitherto unrecognised damental property of matter, the most recon- e is that due to Swann. He modified the tromagnetic equations slightly, by the addition of small terms depending not only on v, the velocity of the electric charge, as in the classical theory, but also on $\dot{v}$ and $\ddot{v}$. His additional terms are such that no new effects arise merely through uniform *translation* of matter; that is, the equations remain invariant under the transformation of the restricted theory of relativity. The terms contain a factor, the form of which is chosen so that in the case of uniform *rotation* of neutral matter, with angular velocity ω, they imply the existence of a current density proportional to $\omega^4 r^3$, at distance r from the axis; this law of variation of the hypothetical current density was shown by Swann to be the only suitable simple law that will give magnetic fields of the right relative magnitude for the sun and the earth,[5] and a very small field for rotating bodies in the laboratory. Finally, by appropriate choice of a numerical constant involved in the new terms, the theory is made to fit the actual magnitudes of the solar and terrestrial fields. The whole procedure is elaborately *ad hoc*, and therefore somewhat unattractive, despite the skill with which the theory is developed. While the modified equations fulfil their intended purpose without appearing to introduce discrepancies with other observed facts, only one new consequence was inferred from them, namely, that small, rapidly rotating non-magnetic bodies should have a minute but just measurable field. Swann and Longacre have recently succeeded in testing this prediction, which is found to fail.

On the whole, it seems to me unlikely that cosmical magnetism has any fundamental significance in physics, involving, as in Swann's theory, small modifications in the general laws, which reveal themselves only in rotating bodies of great size. Any such hypothesis leads to a field symmetrical about the axis of rotation, whereas neither the sun's nor the earth's field is of this type; the obliquity of the magnetic to the rotational axis is about 4° for the sun, and about 12° for the earth. Thus the transverse component of the field, which a fundamental rotational theory cannot explain, amounts to a few per cent of the axial component. The secular variation of the earth's field is a further non-axial phenomenon of the same relative order of magnitude.

These asymmetrical features must be ascribed to causes which cannot be fundamental, and as they are not greatly inferior to the axial fields, it seems unnecessary to invoke fundamental hypotheses for the latter. Therefore in my opinion cosmical magnetism is probably only a secondary, though possibly widespread, phenomenon, and not a universal fundamental one like gravitation. If this be so, theories of cosmical magnetism must involve factors of an accidental character, not too rigorously determined *a priori*, in order that they may account for the varied secondary features of the solar and terrestrial magnetic fields. In this respect Larmor's semi-hydrodynamical theory seems preferable to hypotheses like Swann's.

[5] Owing to the uncertainty as to the true maximum intensity of the magnetic field of the sun, it is unsafe to attach much importance to the observed ratio of the solar and terrestrial intensities.

The Electrical Conductivity within the Earth.

Though the cause of the earth's magnetism and its secular variation is still uncertain, the study of these phenomena is likely in time to add materially to our knowledge of the earth's interior. At present our knowledge of this region is derived mainly from quite different lines of evidence; every fresh sidelight on this *terra incognita* is worth the most careful attention. The secular variation suggests that, despite the mechanical stability of the earth, fairly rapid changes are proceeding within it, and that the interior is much more mobile than the outer layers: when the variation has been observed over a longer period, detailed inferences as to the nature of the internal changes should become possible. Already, however, terrestrial magnetism has provided one definite fact regarding the earth's interior, which could scarcely have been obtained otherwise; hitherto no use has been made of it in theories of the constitution of the earth, and perhaps laboratory experiments are required before this will be feasible, but the fact must sooner or later be taken into account.

If a conducting body be placed in a varying magnetic field, electric currents will be induced in it; the more rapid the variation of the field, the greater the current-density near the surface of the body, and the thinner the layer wherein the currents flow. The currents shield the interior from the varying magnetic field by superposing an opposing field of their own, while outside the body their field strengthens certain components of the original field. If the body is spherical, by harmonic analysis of the surface field we can separately evaluate the parts of external and internal origin; the method, due to Gauss, was first applied for this purpose by Schuster, to the *daily variation* of the earth's magnetic field. It is found that the daily-varying part of the field is mainly of external origin, but there is a smaller part of internal origin; Schuster ascribed this to currents induced in the earth by the outer varying field. In conjunction with Lamb, he showed that the ratio of the intensities of the external and internal parts of the field, together with the difference of phase between them, are inconsistent with the assumption that the earth is a uniformly conducting sphere. The magnetic data show, in fact, that the effective conducting sphere must be smaller. The depth of its surface is estimated to be about 200 miles, and its specific electrical resistance ρ is about 3×10^{12} e.m.u., or roughly 300 million times that of iron at ordinary temperature; naturally there is no reason to suppose that the resistivity undergoes a quite sudden transition at this depth. The resistivity 3×10^{12} is, however, 400 to 4000 times less than that of dry earth or rock, of which the outermost layer is formed, so that a great change of composition or state must occur at about 200 miles depth. There appears to be no other geophysical evidence of a rapid change in properties at this level inside the earth.

Even the outermost layer of the earth is sufficiently conducting for measurable currents to flow in it, but they are too weak to shield the conducting core from fields which vary with a period of the order of a day. During magnetic disturbances much quicker variations occur, and the measured earth currents, which are far stronger than usual, may have an appreciable shielding effect. The *oceans* are more highly conducting ($\rho = 2 \times 10^{10}$) than either rock or the conducting core, and if they covered the globe uniformly to a depth of half a mile the currents induced in them by the daily varying field would shield the interior almost completely, and the existence of the conducting core would not be disclosed; actually, the oceans are so broken up by land masses that the shielding effect of the currents induced in them is greatly reduced.

If the core is of *uniform* resistivity 3×10^{12}, the currents induced in it by the daily variation of the earth's field will decrease downwards until at a depth of about one-tenth its radius they are very small, and the outer varying field is almost annulled. The conductivity below this depth is therefore of no significance in relation to the daily magnetic variation, and we remain in ignorance of it. Our existing knowledge refers to a total depth of about 600 miles, or less if the conductivity of the core increases downwards; this outer layer shields the interior from outer varying magnetic fields of period one day or less. The conductivity of the deeper interior could be explored only by means of fields—which must be on a large scale, comparable with the earth's size—that vary much more slowly. There is an annual variation of the earth's field, probably of external origin, but it is small and not well determined: in time it may be used to ascertain the conductivity at lower levels, but at present this is not possible.

If the whole earth below 200 miles depth had the uniform resistance 3×10^{12}, freely decaying currents within it would be reduced in the ratio 10 to 1 in about five days: hence any currents producing the main field and the secular variation would have to be continuously maintained; moreover, the secular variation would be scarcely affected by self-induction, because its changes are periodic, if at all, only in a far longer interval, of hundreds of years. It may be, however, that the conductivity goes on increasing towards the earth's centre, the increasingly metallic character outweighing the opposing influence of rising temperature, and possibly also pressure, on the conductivity.

Fig. 6 shows in crude outline the estimated electrical resistance of different strata in the earth, and of the Heaviside layer in our atmosphere. It also shows the theoretical estimates I have made for different depths within the sun, which at the centre is probably nearly as good a conductor as copper is at ordinary temperatures.

Radial Limitation of the Sun's Magnetic Field.

Leaving terrestrial problems, let us again consider the sun's magnetic field. It has been seen that the tubes of magnetic force in the sun's atmo-

here lie nearly horizontal, and do not spread out to space as do those of the earth. Since the tubes are necessarily closed, they must complete their course inside the sun.

Hence the northward tubes observed in the sun's atmosphere must turn and become southward in the interior. Near the surface the force is northward and increasing downwards; since at some greater depth it is reversed in sign, it must first attain a maximum northward intensity and then decrease, become zero, and increase once more with the opposite sign. The depth and magnitude of the maximum northward intensity are unknown, and *a fortiori* the depth at which the force is reversed; if we knew these quantities, we could calculate the mean intensity of southward force below this depth, since as many tubes go northward as return southward.

By considering a line-integral of the magnetic force round a contour, in any meridian plane, formed of horizontal and radial lines, it appears by Ampère's rule that electrical currents must be flowing round the sun's atmosphere, along the circles of latitude, in the easterly direction as reckoned by an observer situated on the sun. The eastward electric currents extend approximately down to the depth of maximum northward force, below which the currents are westward—unless, which is perhaps unlikely, the field and the currents are reversed more than once inside the sun.

The *westward* currents are the primary cause of the sun's magnetic field, and their origin is the fundamental problem of solar magnetism. I have already described the theory, due to Larmor, which seems to give a possible explanation both of their origin and also of the earth's field. The second major problem of solar magnetism is afforded by the restriction of the field within the solar atmosphere. The immediate cause is the eastward current-system, which has the same effect as a shell of highly permeable magnetic matter enclosing the sun; it superposes an additional magnetic field which, in the external space, neutralises the primary field, while intensifying this field within the layer. The eastward currents cannot be the main cause of the sun's field: if they alone were present, their field would spread outwards into space.

It appears possible to account for these eastward currents in a simple manner by a theory which also enables the magnetic intensity to be used to calculate the pressure in the solar atmosphere, and gives a value agreeing well with that deduced in a totally different way by Milne.

The solar atmosphere is so hot that most of the atoms in it are ionised. The ions and electrons are subject to an electromagnetic force due to their motion in the magnetic field, and also to vertical gravitational and electrostatic forces. The electrostatic force is due to the tendency of the very light electrons to rise towards the top of the atmosphere. This tendency is almost entirely prevented, but a very slight separation occurs which suffices to equalise the downward forces on the ions and electrons; the ions are half supported by the electrostatic field, while the electrons are held down by it with a force equal to half the ionic mass.

Apart from these vertical forces, each of the ions and electrons would spiral round some line of magnetic force, the average motion therefore being to the north or south. Since the ions and electrons move equally to north and south, no average

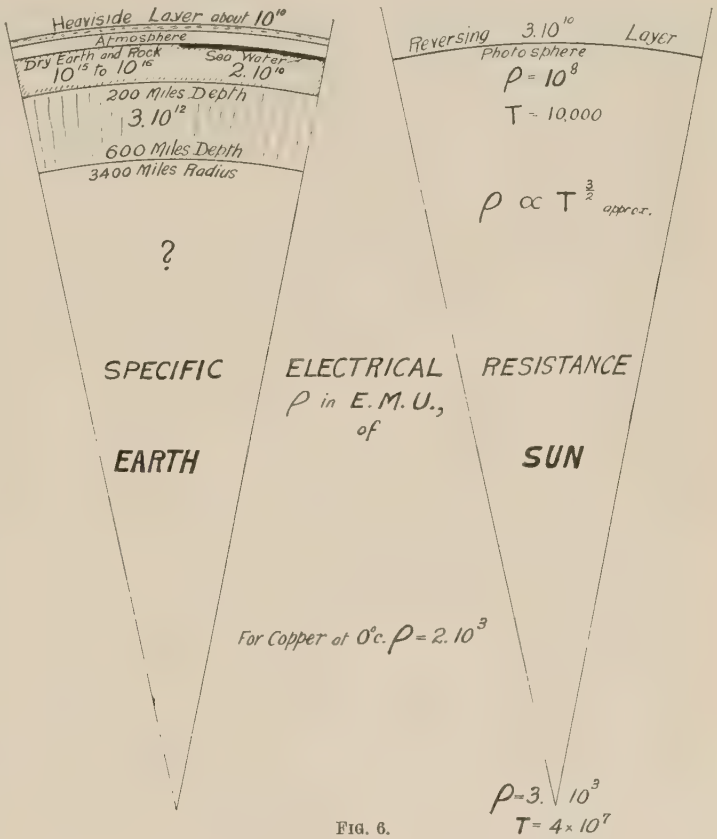


FIG. 6.

current results, and this motion along the magnetic field can for simplicity be ignored. The vertical force produces a constant downward acceleration of the free charged particle, but the magnetic field continually deflects the velocity round the lines of force, without affecting its magnitude. While a particle is moving downward its velocity is increasing, owing to the vertical force, but the magnetic field rotates the velocity, so that the motion becomes first horizontal and then upward again; during the upward motion the velocity is diminished by the vertical force, and turned so that the motion again becomes horizontal and then downward. The horizontal velocity at the top of the path is less than at the bottom, and the effect of the vertical force is to impart an average horizontal motion in the direction of the velocity at the lowest point of the path; there is no average vertical

velocity or acceleration. The motion, projected on the plane normal to the magnetic force (the vertical plane in the east-west direction), from being circular becomes trochoidal, the average velocity being to east or west. The motion is westerly for the electrons, which, viewed from the south, spiral round the field in the clockwise direction; for the positive ions, the motion of which is anti-clockwise, it is easterly. In either case the motion is equivalent to an easterly current, such as must exist in the sun's atmosphere, where the magnetic intensity is decreasing upwards; I have termed this current a 'drift' current, since it is not due to an electromotive force in its own direction, but to a transverse force. A mechanical analogy of this drift is well known. A rough sphere placed upon an inclined plane which rotates uniformly about some axis normal to itself acquires no mean motion down the plane, but describes a trochoidal path with its mean motion horizontal, transverse to the component of gravity down the plane.

Such drift currents will have free play only if the gas is sufficiently rare for the particles to execute many turns in their trochoidal paths between collisions with one another. This requires that the radius of the spiral is small compared with the mean free path of the particle. The mean free path is much the same for the ions and electrons, but the spiral radii are very different, being approximately in the ratio of the square roots of their masses; thus the electrons may be free to spiral and to drift when the ions cannot do so; this appears to be the case in the sun's reversing layer, where the magnetic field is observed. A simple calculation then shows that in this region $dH^2/dp = 8\pi$, where H denotes the magnetic intensity and p the electron pressure. The distance within which the decrease occurs can also be calculated, and proves to be only about 20 km.

It is not possible at present to infer theoretically how far the magnetic field is likely to *increase* as we go downwards into the photosphere; the increase is limited by the fact that the mean free path decreases downwards in the ratio $1/p$, while the 'spiral-radius' of the electronic paths decreases as $1/H$ or, approximately, as $1/p^{\frac{1}{2}}$. Hence the mean free path is reduced the more rapidly, and when it becomes approximately equal to the spiral-radius, the electronic drift current will cease. This must occur within 100 km. of the photosphere, but the calculation of the exact level is rendered difficult by the indefiniteness of the mean free path in the case of particles which are not rigid spheres, but behave like point centres of force, particularly when the law of force is the inverse square law of electrostatic action.

In these calculations no account has been taken of the influence of the magnetic field on the mechanical equilibrium of the sun's atmosphere. The field partly supports the free charges, and an atmospheric layer of given total mass will therefore be more spread out, in the vertical direction, than if the field were absent. When this effect is allowed for, the formula $dH^2/dp = 8\pi$ is modified, but the drift-current theory of the radial limitation of the field is not essentially changed.

Terrestrial Drift Currents and other Electromagnetic Phenomena.

Similar effects must occur in the earth's atmosphere, which is ionised at high levels by solar radiations. Eastward drift currents will flow at heights where the mean free path is larger than, or comparable with, the spiral-radius of ions and electrons; in the earth's field, at the equator, the spiral-radius is about 2 cm. for an electron, and 5 metres for an ionised oxygen or nitrogen molecule; consequently *electronic* drift currents will occur at heights above about 70 km., and *ionic* drift currents above about 150 km. But the number of electrons and ions is much less than would be required to enable the drift currents to shield the outer space from the earth's magnetic field; less than 5 per cent of the tubes of force crossing the earth's surface are confined within the atmosphere by the drift currents. This estimate is derived from the spherical harmonic analysis of the earth's field, which shows that only about 3 per cent of the surface intensity is due to overhead currents; from this it is possible to infer that there are less than 10^{16} ions per sq. cm. column of atmosphere, above a height of 150 km. An independent check on this estimated upper limit will become available before long from measurements of the ionic density at different heights, by means of the reflection of wireless waves by the upper atmosphere.

Besides these major problems, there are others of equal theoretical interest, which relate to smaller or local components of the solar and terrestrial magnetic fields. The solar corona appears to indicate the existence of a magnetic field, probably of low intensity, above the chromosphere. Among the further phenomena of terrestrial magnetism, the chief are the solar and lunar daily variations, and magnetic storms with their associated auroræ; these originate above the earth's surface, in or outside our atmosphere. They have important connexions with solar physics, and also with so practical a matter as radio propagation; in recent years the electrical exploration of the upper atmosphere by beams of radio waves has lent powerful aid in their investigation. During the past century some progress has been made towards a physical theory of these changes, but much more remains to be done.

The problems involved, like those relating to the main field of the earth, are of rather long standing; they probably depend only on the working of already known laws, in ways not yet recognised, and therefore they do not possess the importance that attaches to such problems as those of atomic physics; nevertheless, they have much fascination and interest, and until they are solved they constitute a challenge to the theoretical physicist; in time the challenge will be met, but that time may be still distant.

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bits auxiliary to local industry come from the h. The Cambridge Scientific Instrument Com- supplies its pyrometers to brick and tile ks.

ne natural advantages already described are to those who wish to start new industries. In nicals, iron, engineering, and shipbuilding it be less easy to begin on a small scale than it a century ago with less powerful competitors. the district seems a good one for new inventions ating new patents. Coal, gas, and electric ent are available as power. There is a net- of railways and motor-bus routes. There is rabundant labour already somewhat housed. ventures will be welcomed by a population tant to emigrate although ill-advised in leav- nitiative to others. The large-scale models of Tyne Improvement and Tees Conservancy missioners will help in the choice of sites for ories; the L.N.E.R. is also ready to advise. stries scarcely yet acclimatised include the ing of agricultural machinery and motor- es.

his exhibition goes much further than earlier mpts to restore confidence by talking con- ce. The goods are ready. The method of rtisement is being pushed for all it is worth. d has gone out through the world in English, ch, German, and Spanish. There will be con- ces of advertisers, of international foundry- and notably the Baltic and White Sea Con- ce. The success of the exhibition is to be ed by orders for ships, bridges, and machinery er than by gate-money on bank holidays. The od of advertisement may have its limits; it lead to private profit at the price of public e. The exhibition and its catalogues are mples of economy in advertisement by co- ation, a stepping-stone towards the trans- ation of advertisement into a public service. relation of the co-operative wholesale society e co-operative stores in the pit-villages tends rds the tied-house principle, eliminating the for advertisement. Even if the method of rtisement cannot command success, it is doing it can to deserve it.

much for the microcosm in which the scientific orer will find himself if he comes to make the oition a starting-point for some survey of the n-east of England. The causes of present distress been incompletely advertised. It is not only st-War slump in munitions. For fifty years side has been content to make high profits and wages whilst specialising in the production of tions. Nemesis has come home with a venge-

There is a heavy load of the disabled to rried; the education of the blind is the only al educational exhibit. The unemployed in- the less employable and the less versatile. ership has been decimated. Unemployment name for a scarcity of employers is a view not nasised by labour leaders. Labour propaganda ooked numbly to the State. During the coal page of 1926 it may have seemed right to say on and hope. In retrospect, emigration would have been wiser. Many of the inland coal mines, for example near Bishop Auckland, are worked out, though the deeper mines near the Durham coast are at work. It seems a tragic mistake that emigration has been discouraged by those to whom the miners look for advice. The Lord Mayor's Fund has been a gesture of generosity; it only makes idleness a trifle less intolerable.

Various tempers of mind—religious, philanthropic, political—have already been applied to our problems without yielding complete solutions. Before prescribing panaceas we need the whole truth. It is whispered that in the past it has been far too easy to make money on Tyneside. This view is endorsed by Dr. H. A. Mess in "Industrial Tyneside". Traditional industries have scarcely thought it necessary to bring in scientific advice; even to-day a chemist is felt to be out of place on a board of directors. Some industries requiring high intelligence have left the district; electric lamps and aniline dyes are examples. So far there is too little response to the offers of the National Institute of Industrial Psychology to help in selecting personnel and arranging work. There is a reluctance to climb down from high prices, high profits, and high wages.

What is to be done if the method of advertisement fails? The restoration of the general prosperity of our neighbours beyond the North Sea is urgent. A voluntary Interessengemeinschaft between chemical firms, already in the imperial stage of evolution, would be a safeguard against future misuse of nitrates and by-products. Armstrong College, fed by scholarships through the secondary schools, is preparing the next generation of employers. Even if the rest of England hesitates there seems a fair case for asking for a prior and immediate application of the Hadow Report raising the school age by one year in the colliery areas. For the next or prevocational year up to age sixteen the teachers are still to be discovered and trained. A great development of junior technical schools is desirable until every young person has at least one and preferably several ways of earning a living. It is proving very difficult to reconvert townsfolk into agriculturalists. There is a Migration Training Hostel for boys in Walker, and a Domestic Training Hostel for girls in Benton, but what are these among so many?

Emigration is probably urgent and almost without waiting to ask whether the new countries will speak Russian, Spanish, or Dutch. When customers are invited from all nations it seems absurd to limit emigration to the British Empire. The nations emigrating to America have faced a new language and an alien culture. A generation ago the Irish had to leave home: a like fate is before our boys and girls. The best ages for emigrating are said to be sixteen to twenty-three, and the best form of assistance education and training whilst still near home. Some sort of vocational guidance might be offered to every one, followed by technical training according to capacity. The boys and girls in their school caps and badges are seen eagerly examining the exhibits; to them the exhibition is a means of education.

HUGH RICHARDSON.

South Africa Meeting of the British Association.

THE meeting opens on Monday, July 22, and for the convenience of members who arrive in Cape Town before this date, offices and reception rooms are being opened in the old University Buildings, Queen Victoria Street, on July 15. Business in connexion with railway travel and with local excursions will be transacted at these offices. The meetings of the sections will be held in the new University buildings at Groote Schuur, Rondebosch, which can be reached by rail, tram, or bus from Cape Town.

Local excursions to points of interest and beauty in the Cape Peninsula are being arranged, and the Royal Observatory will be open for inspection. It is hoped that the cable railway to the top of Table Mountain will be ready for traffic, thus facilitating the ascent. For visitors interested in geology, excursions are being arranged for an inspection of the granite-slate contact at Sea Point and to Chapman's Peak, where a general idea of the structure of the Cape Peninsula can be obtained. On the way from Cape Town to Kimberley, geologists will have an opportunity of inspecting the Folded Mountain Belt, the Cape System, and the Karroo System; at Kimberley they will be able to inspect the diamond mines and the glacial phenomena of the Dwyka Series. Thereafter, on arrival at Johannesburg and Pretoria, they may link up with the International Geological Congress.

It is anticipated that about 550 visitors from overseas will attend the meeting, and the transportation of these, together with a number of local members, by rail from Cape Town to Johannesburg in a limited time will tax the resources of the railway, which runs for most of the way as a single track and has many steep gradients. A special train for local members will leave Cape Town on Saturday, July 27; two special trains for visiting members will leave Cape Town on the morning of Sunday, July 28, and two more on the morning of Monday, July 29. Each of the parties of visiting members will spend about twelve hours at Kimberley, and will then proceed to Johannesburg, where they will arrive on July 30 and July 31.

At Kimberley the diamond mines of the De Beers Consolidated Mines will be visited. It is anticipated that practically all of the visitors will desire to see the workings of a gold mine. The underground workings of the mines can only be visited during the early part of the day, as all underground passages must be cleared for blasting operations during the afternoon. The visitors will be taken in small parties to various mines; for those specially interested a small party is being organised to visit one of the deep, hot mines.

Astronomers will be afforded an opportunity to visit the Union Observatory and the Yale telescope, which is housed in the grounds of the University of the Witwatersrand.

The meetings of the sections in Johannesburg will be held in the University of the Witwatersrand, and the premises of the Associated Scientific and Technical Societies of South Africa, in the centre of the town, will be available for the visiting members.

Visits have been arranged to the Rand Gold Refinery, to the explosives factory of African Explosives and Industries, Ltd., at Modderfontein and to the Royal Mint at Pretoria. The large air compressors of the Victoria Falls Power Company at Rosherville will be of interest to engineers, as will also be the Central Electric Power Station at Witbank. The Rand Water Board has arranged a visit to the barrage across the Vaal River and to the waterworks at Vereeniging. For anthropologists visits can be arranged to the Leslie collection of stone implements at Vereeniging, to stone circles at Aasvogel Kop and at Heidelberg, to the native stads at Rustenburg, and to stone huts at Vechtkop (Heilbron, O.F.S.). Several botanical excursions are being organised, as also are visits to institutions of an educational character. The South African Institute for Medical Research at Johannesburg and the Government Veterinary Research Laboratories at Onderstepoort, near Pretoria, will be open for inspection. On the morning of Sunday, Aug. 4, exhibitions of native war dances will be given. A display of tribal types is being organised by the Witwatersrand Native Labour Association, which should prove to be a particular attraction to all overseas visitors. From Pretoria a visit will be made to the Premier Diamond Mine.

Under the auspices of the South African Association, a handbook dealing with South Africa from the travel and scientific aspect has been prepared for presentation to visiting overseas members. The book contains a foreword by His Excellency the Earl of Athlone, Governor-General, and chapters on travel in South Africa, Southern Rhodesia, government, education, geology, gold, diamonds, other minerals, agriculture, vegetation, fauna, astronomy, anthropology, medical research, commerce, and game reserves. The book will be available to members at Cape Town, and the information in it should add to the interest of the visit to South Africa. Portfolios of etchings will be presented to overseas members at Cape Town; the etchings depict typical South African scenery and architecture (chiefly in the neighbourhood of Cape Town), and will form a not uninteresting souvenir.

At the opening session on Monday, July 22, at Cape Town, members of the British Association will be welcomed to South Africa by His Excellency the Governor-General. At this session the South Africa Research Medal (founded in commemoration of the visit of the British Association to South Africa in 1905) will be presented to Dr. Robert Broom for his archæological and anthropological researches.

The South African Association has extended invitations to a number of scientific workers to attend the meeting in South Africa as guests, and Prof. O. Abel, Sir J. C. Bose, M. l'Abbé Breuil, Prof. C. Dragoni, Prof. A. S. Eddington, Prof. A. Hitchcock, Prof. G. A. F. Molengraaf, Dr. C.

rs, Sir John Russell, and Dr. W. de Sitter are cted to be present.

ne evening at Cape Town will be devoted to a ission on science and industry, which will be inued on another evening at Johannesburg.

ne meeting concludes officially at Johannesburg ug. 3 ; thereafter most of the visitors will proceed on sight-seeing tours, and doubtless many of them will take the opportunity of visiting the Victoria Falls. One party will assemble at Durban towards the end of August, and a semi-official session will be held there ; this party will be joined by the president, Sir Thomas Holland, who will give a special address at Durban.

News and Views.

N important step in the development of the Waite itute for Agricultural Research, South Australia, taken when the John Melrose Laboratory was ially opened at the end of April. The Institute established some years ago as the result of a gift the late Mr. Peter Waite to the University of laide for the purpose of furthering education and arch in agriculture and allied subjects. The wment comprises the Urrbrae, Claremont, and nerby Estates lying on the scarp of the Adelaide ills within four miles of the city and consisting early 300 acres. In addition there is a trust fund 58,450. Of recent years considerable assistance been forthcoming from the State Government, ire Marketing Board, the Council for Scientific Industrial Research, Imperial Chemical Industries, , and the Commonwealth Bank of Australia. need for increased laboratory accommodation been acutely felt, and, mainly through the gener- of Sir John Melrose in providing the sum of 000, a wing has been completed of what will in constitute a large block of laboratory buildings.

HE Melrose Laboratory at the Waite Institute ains two main floors, the ground floor being ted to administrative and botanical work, and the floor mainly to chemical work, but with provision for entomology. The entire content of the build- s approximately 274,000 cubic feet and the total space 14,700 square feet. Quite possibly further nsions may soon prove necessary, as it is under- d that the Council for Scientific and Industrial earch and the University of Adelaide are dis- ing a project for establishing jointly at the itute a Division of Soils Research. The need for ve of the kind has been very apparent in Australia ome time, and there can be little doubt that its blishment at the Waite Institute would be a wise e, as this Institute is rapidly becoming one of the t important centres of agricultural research in the mmonwealth.

ESSRS. SOTHERAN, LTD., booksellers, Strand and adilly, have in their hands and are proposing to *en bloc* a collection of some eight hundred and y books which undoubtedly formed a part of a ry brought together by Sir Isaac Newton. It been known to a past generation that at Newton's h a large mass of papers, annotated copies of his and other authors' works, and an extensive cor- ondence with English and foreign mathematicians, ained with Mr. Conduitt and his wife. Ultimately e of this series which related to science were pre- ed to the University of Cambridge in 1872 by the Earl of Portsmouth, and were reported on in 1888 over the signatures of such authorities as H. R. Luard, G. G. Stokes, J. C. Adams, and G. D. Liveing.

THE works that actually constituted Newton's library occupy, however, a different niche in history, unrecorded as an entity by his biographers. One may, perhaps, conjecture that the volumes were left intact at the house in St. Martin's Street, Leicester Fields (occupied for so long by the philosopher), and not removed on his change of quarters, through ill-health, to Kensington, where he died within a brief space, in 1727 ; certainly the old residence was still on the rate books of his former parish at that date. Twenty books in the above collection bear Newton's autograph ; four are dated 1661 ; whilst eighty-three carry, here and there, notes in his handwriting. The first and second editions of the "Principia" (with numerous corrections) are prime items of interest in the set. Some of the books have presentation inscriptions to Newton by their authors ; others are finely bound in contemporary morocco. A Latin-Greek Dictionary (1650) with autograph, has the date Mar. 29, 1661, presumed to be the earliest known Newtonian signature, in any case, written shortly before he entered Trinity College, Cambridge.

FROM a reprint of the correspondence between Isaac Newton and Robert Hooke during the years 1679–1680, published in chapter viii. of Rouse Ball's "Essay on Newton's Principia", pp. 138-153 (Macmillan), 1893, two letters were missing. These letters "are known to have been written, but they have never been published, and it is possible that no copies of them are now extant". The correspondence dealt with the question of the path of a falling body, "moved circularly by the diurnal motion of the earth, and perpendicularly by the power of gravity". The first of the missing letters was read to the Royal Society on Dec. 11, 1679, two days after Hooke sent it to Newton. The reply from Newton, dated Trin. Coll., Dec. 13, 1679, and addressed : "For Mr. Robert Hooke, at his Lodgings in Gresham College in London," was discovered in a collection of autographs, sold in 1904 by Messrs. Sotheby to the British Museum. Thanks to the courtesy of the Keeper of the Manuscripts, Dr. Jean Pelseneer of Brussels has been permitted to print (*Isis*, xii. No. 38, May 1929) the hitherto unpublished letter. The 'find' is not only interesting in itself for the part that it played in the history of the genesis of the "Principia", but also as an earnest of more to come. Thanks to the assistance he has received from the Belgian National Fund for Scientific Research, Dr. Pelseneer hopes to bring before the public further

documents by Newton which have not yet been published. We may add that in the *Isis* article of 16 pp. he gives his readers an excellent summary of the correspondence, with the circumstances in which it was written.

THE Meteorological Office, Air Ministry, has issued a special report upon the shortage of rain over the British Isles during the period of six months including December last and the first five months of the present year. Except to certain sections of the community who for special reasons are intimately concerned with the total amount of rain during such a long period, as for example farmers and engineers who deal with water-supply, a shortage of the kind under consideration may easily pass unnoticed. This is particularly the case when the dry spell has been marked by not infrequent periods of dull, windy and wet weather during which appearances have been misleading and the amount measured in a rain-gauge has been trifling. The official report is accompanied by a map showing the rainfall for the six months expressed as a percentage of the normal fall for the same period. This map reveals the fact that only the coastal districts of the south of Ireland and the extreme south-west of England show any considerable areas where there has not been a deficiency, and that over a considerable part of north-west Ireland, western Scotland, Wales and England, there has been less than half the usual quantity.

AMONG places mentioned in the report which show particularly low percentage amounts of rainfall are Llangurig (Montgomery), with 30 per cent; Rhyader (Radnor), with 35 per cent; Margate, 36 per cent; Fort Augustus (Inverness), 38 per cent, and Aspatria (Cumberland), 39 per cent. At Margate the remarkably low total fall of slightly less than $2\frac{3}{4}$ inches was measured. It is interesting to note that the last month of the series—May—was the only one in which the British Isles as a whole showed a slight excess rainfall above the normal, and there seemed to be some hope that the tendency for drought had come to an end. June has, however, showed some notable dry periods, and when the figures for that month are collected and the period of seven months from last December is considered, the general shortage will probably stand out as one of the most notable, if not the most notable, of any dry period of that length in Great Britain since accurate rainfall measurement began.

THE approaching visit to South Africa of the British Association has undoubtedly stimulated interest in its many archæological and ethnological problems, not least perhaps those which centre in the prehistoric stone buildings, of which the greatest and best known is Great Zimbabwe. In addition to the expedition, of which Miss Caton-Thompson is the leader, sent out by the British Association itself, and the independent investigations being carried out under permit of the Rhodesian authorities by Dr. Leo Frobenius, an Italian expedition is in the field. It has been sent out under the auspices of the Royal University of Florence. One of the members, Dr. Lidio Cipriani, professor of ethnology in the University of Florenc is reported in the *Times* of June 21 to have arrive at the conclusion that the Zimbabwe collective are a native product, the work of an African peop without any foreign influence. It is to be hoped th Dr. Cipriani may have an opportunity of laying h views before the Association. Dr. Cipriani is al reported to have discovered some Bushmen paintin of exceptional significance. They exhibit the featu of superposition, a painting of an Arab typical dressed having been found under a picture of a Bus man fighting Bantus. This, needless to say, confirm the relatively late date of the Bushman painting some of which indeed are known to be quite moder These paintings were found in the Marandellas distric An engraving found at Mazabuka is said to be lik nothing found elsewhere in Africa and to give certai indication of prehistoric man. The description, hov ever, is too vague to give any clear idea of i character.

As was announced in our issue of June 22, p. 95 by arrangement with the Air Ministry and Messr Wireless Pictures (1928) Ltd., synoptic weather chart are being broadcast from the Daventry Station (5 XX of the British Broadcasting Corporation every Tue day and Thursday between 2 P.M. and 2.25 P.M. Re ports of the reception of these charts on a Fultograp from as many different places as possible will be c the greatest value to the experimenters. Any pos sessor of a Fultograph can obtain a supply of prepare paper and envelopes and also full particulars of th reports required by writing to Wireless Pictures (1928 Ltd., Dorland House, 14-16 Regent Street, Londo We hope that the results will demonstrate that it i possible to send in a few minutes from a central statio to all parts of the country, and to airships and aero planes in flight, weather charts and forecasts. It wi be of the greatest value for pilots to see at a glance th state of the weather in the districts to which they ar flying.

THE history of Danish broadcasting is a notabl example of the wisdom of State encouragement o amateur effort. In the *Wireless World* for June 1 a good account is given by P. O. Langballe of th rise of broadcasting in Denmark. In 1922 it cam into existence almost accidentally. Government test were being made with the view of establishing radi telephony between the mainland and the Island o Bornholm, using a Poulsen continuous wave trans mitter. During these tests several amateurs wer surprised to hear something that sounded like th scratching music made by an old gramophone. Whe regular reception was established, it was foun impossible to prevent 'listening in'. Private trans mission, however, was forbidden. This led to th formation of the Danish radio club, the members o which were anxious to secure the same privileges a radio enthusiasts in other countries. A moder valve transmitter was erected at a station just outsid Copenhagen. Although the plant was supplied b the State, its operation and maintenance were en trusted to the radio club. This arrangement provin

uccess, no difficulty was experienced in getting mission to erect a broadcasting station in Copen- en itself, funds being provided by the State and ew private subscribers. The club operated this station at first, but as the programmes became porate and the expenses heavy, the State assumed trol and a radio bill was passed taxing all listeners. tax is now a uniform one of ten crowns per annum. first relay stations were fitted on the passenger mers between Copenhagen and Jutland. They ked up the Copenhagen programmes and trans- ted them. A high power station has now been lt at Kalundborg on the western coast of Seeland. ratio of licensed listeners to the total population reater in Denmark than in any other country in world.

AN expedition under the auspices of the German vernment to study the ice-sheet of Greenland is ng undertaken this year. Prof. A. Wegener, who had previous experience in Greenland, will be in rge. This year's work will be by way of prepara- for the main undertaking next year. According the *Geographical Journal* for June, three stations be established in the same latitude but at wide rvals. The first will be about 12 miles within ice-sheet in the Umanak district. The second be in the central part of the ice-sheet, and the d will be on Scoresby Sound. Wintering parties inhabit all the stations and take the temperature the ice at different levels. Radio and weather casting stations will be established at the three ions. It is proposed to use motor sledges as well logs and Icelandic ponies in transport.

N his address to the Royal Geographical Society at annual general meeting on June 24, Sir Charles se referred to the growing value and importance ir surveys. Some attempts at aerial photography e made last century, but nothing practical in aerial vey was achieved until the aeroplane supplanted balloon as a means of air transport. It was during War that air photography became a recognised hod of survey. Sir Charles Close went on to give e account of air surveys that have been made or in process of completion. Perhaps the out- nding example of aerial survey is that of the diffi- country in Brazilian Guayana along the Rio ro, Rio Branco, and Rio Parima. The whole is ered with dense forest, but about 12,000 square es were photographed in 174 hours. Then the ail was fitted into a framework of astronomically d positions which were made along the rivers. As uick means of survey in new countries, aerial photo- phy has been used in Northern Rhodesia, Iraq, ma, and the Rio de Janeiro district in South erica, the Malay States and elsewhere. Rapid rovements in the cartography of many of the less wn parts of the world are thus rendered possible.

A LARGE earthquake was recorded at Kew Observa- y on June 27. The first tremors reached the ervatory at 13 hr. 1 m. 38 sec. G.M.T. The epi- tre is estimated to have been 7500 miles away, but the initial impulse was too small to be any indication of the bearing.

MR. L. BELLINGHAM, of Messrs. Bellingham and Stanley Ltd., 71 Hornsey Rise, N.19, reminds us that the electrification of omnibuses described by Prof. C. V. Boys in our issue of June 29 was pointed out by him in NATURE of Sept. 10, 1927, p. 367. He believes the charge is the result of the friction on the brake drums rather than the rolling of the tyres on the asphalt, because he has noticed it particularly on the buses descending Crouch Hill on the portion of the road which is paved with granite setts. These small electric shocks are well known to the conductors, but they attribute it to a slight leakage from the magneto.

IT is probably known to our astronomical readers that for the measurement of positions and areas of sunspots a collection of solar photographs for each day of the year is made at Greenwich with the co-operation of the observatories of the Cape and Kodaikanal. In most cases there are two or more photographs for each day. One complete set is preserved at the Royal Observatory, and we are informed that arrangements have recently been made for a duplicate set to be stored at the Science Museum, South Kensington. This has the great advantage of housing two complete sets at different places, in case of accident; also the set at the Science Museum is easily accessible to students of astronomy and magnetism who may wish to consult the negatives.

AT the meeting of the Geological Society held on June 26, the following foreign members were elected: Prof. Charles Schuchert, of Yale University, New Haven, Connecticut; Prof. Pierre Termier, Directeur des Services de la Carte Géologique de France, Paris; Dr. Edward Oscar Ulrich, U.S. Geological Survey, Washington, D.C.; and Dr. Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, University of California. Foreign Correspondents were also elected as follow: Prof. Othenio Abel, of Vienna; Dr. Clarence N. Fenner, of Washington, D.C.; Prof. Olaf Holtedahl, of Oslo, Norway; Dr. Rudolf Staub, of Berne, Switzerland; Dr. V. K. Ting, of Peking, China; and Prof. Carl Wiman, of Upsala, Sweden.

IN the Calendar of Patent Records which appeared in the issue of NATURE for June 1, the entry relating to the invention of vaseline referred to the provision of the law which denies registration as a trade-mark to a commonly-used descriptive word, and cited 'vaseline' as a case to which this provision had been applied by the British Courts. Mr. R. F. Kennedy, 12 Church Street, Liverpool, has pointed out, however, that although the lower Court ordered the removal of the mark 'vaseline' from the register on the grounds stated, this decision was afterwards reversed by the Court of Appeal, and the registration of the word as a trade-mark, first effected in 1877, remained in force.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A scientific officer and a junior scientific officer on

the Air Ministry Scientific Research Staff, primarily for duty at the Royal Aircraft Establishment, South Farnborough—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (July 6). An engineer for the Fruit Storage Research Station, East Malling—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 6). A lecturer in pharmaceutics at the Chelsea School of Pharmacy—The Principal, Chelsea Polytechnic, Manresa Road, S.W.3 (July 6). A whole-time assistant (male) to the Public Analyst—The Secretary, Health Department, Grey Friars, Leicester (July 6). An assistant lecturer in mechanical engineering—The Principal, Municipal College of Technology, Manchester (July 8). An assistant lecturer in mechanical engineering at the Bath Municipal Technical College—The Director of Education, Sawclose, Bath (July 8). A resident engineer in connexion with the Sea Wall and Embankment Scheme—The Town Clerk, Municipal Offices, Liverpool (July 9). An assistant lecturer in electrical engineering at the Technical College, Bradford—The Director of Education, Town Hall, Bradford (July 10). A headmaster for the Sandown County Secondary School—The Director of Education, County Hall, Newport, I. of W. (July 11). A full-time assistant to take charge of the electrical engineering National Certificate courses—The Principal, Technical College, Wolverton, Bucks (July 12). A resident lecturer in mathematics with subsidiary science—The Principal, Saltley Training College, Birmingham (July 12). An assistant water engineer—The Town Clerk, Town Hall, Bexhill (July 12). An honours graduate as demonstrator in zoology—The Secretary, Queen's University, Belfast (July 13). A lecturer and demonstrator in pharmacy—The Principal, Central Technical College, Suffolk Street, Birmingham (July 13). An engineering assistant in the Highways and Bridges Department of the Surrey County Council—The Clerk to the Council, County Hall, Kingston-on-Thames (July 13). A professor of municipal engineering and town planning and a professor of railway and road engineering at the Royal School of Engineering, Giza, Cairo—The Director, Egyptian Education Office, 39 Victoria Street, S.W.1 (July 15). A full-time teacher for the Marine Engineering Department at the L.C.C. School of Engineering and Navigation, High Street, Poplar, E.14—Education Officer (T.1a), The County Hall, Westminster Bridge, S.E.1 (July 15). A part-time instructor in mechanical engineering—The Principal, Technical School, Watford. A principal of the Kenrick Technical College—The Director of Education, Education Offices, Highfields, West Bromwich. A test assistant to assist in chemical analysis of metals and alloys—The Chief Superintendent (quoting A.355), Royal Aircraft Establishment, South Farnborough, Hants. An assistant mechanical engineer for the Railway Department of the Government of Ceylon—The Crown Agents for the Colonies (quoting M/1581), 4 Millbank, S.W.1. A mechanical engineer in the Ministry of Public Works, Cairo—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. An assistant experimental officer for design duties for Government Establishment at Biggin Hill, Kent—The Secretary, R. E. Board, 14 Grosvenor Gardens, S.W.1.

Our Astronomical Column.

Origin of the Planetary System.—The May issue of *Mon. Not. R.A.S.* contains a paper on this subject by Dr. H. Jeffreys. He gives a résumé of various theories, starting with that of Buffon, who suggested that a massive comet struck the sun. Many subsequent theories supposed that the near approach of another star to the sun caused the outrush of a stream of matter from it by tidal action. The rotations of the sun and planets were explained as due to the return of a portion of the expelled matter to them after it had received a transverse deflection, from the attraction of the star in the case of the solar matter, or of the sun in the case of that returning to the planets. He examines this suggestion numerically, and finds that it does not give rotations of the right order for the large planets. He then examines the suggestion that the other star actually collided with the sun, and that as they separated a long filament of matter was drawn out between them; this, like the tidal filament in the theory of approach without collision, is supposed to have broken up into the planets. It would also receive a rotational motion by the pull of the other star. On certain assumptions, Jeffreys finds that the mass of the filament might be 1/500 of the sun's, and that the periods of rotation of the resulting planets would be of the order of 8 hours, in good agreement with the actual values for the large planets.

Objections had been made to the tidal theory on the ground that close approaches of stars would be extremely rare; obviously actual collisions would be rarer still, so the adoption of the theory would seem to imply that planetary systems are excessively rare in the universe.

Periodic Comets.—*L'Astronomie* for May contains an article by M. F. Baldet in which he gives a useful table of elements of all the comets known to have periods less than 170 years. It is quite up-to-date and includes the two most recent discoveries, Pons-Forbes and Schwassmann-Wachmann II. There are two lists, the first consisting of thirty-one comets observed at more than one apparition. Three of these are marked with an asterisk, indicating that the identity of the objects seen at the two returns is not absolutely certain; twenty-two of them belong to Jupiter's family, one to Saturn's, two to Uranus's, five to Neptune's, and one has a period of 164 years (seen in 1742 and 1907). The second list contains those seen at only one apparition; it contains thirty-five comets, twenty-two of which belong to Jupiter's family; of the others, five have periods between 11 years and 18 years, two between 40 years and 46 years, three between 64 years and 80 years, and three exceeding a century. Two comets of the second list are due at perihelion in the present year. Mr. F. R. Cripps has computed the perturbations by Jupiter of Giacobini's comet 1896V from its discovery to the present time; he finds perihelion occurs next September and gives a search ephemeris in the *B.A.A. Journal*, No. 7. The *B.A.A. Handbook* gives ephemerides for Perrine's and Metcalf's comets, both of which are due at perihelion this year.

Research Items.

oyle as a Philosopher of Science.—In the recent of *Archeion* (vol. 11, No. 1, pp. 1-12), G. W. ggs estimates Boyle in his capacity of a critical constructive philosopher. The author justly rves that Boyle has become a figure of uncertain ortance in science; his claim to recognition is lly based upon the law associated with his e, and upon rather vague statements to the effect he is the father of modern chemistry. The bulk is writings, and the dryness of his style, have otless combined to prevent his ideas from receiv- adequate attention by modern historians of ace. Mr. Spriggs shows that Boyle introduced h improvement in scientific reasoning, acutely cised the old and vexed question of the 'qualities' odies, and, by his conceptions of *minima* (small vided particles) and 'local motion', paved the for fundamental advances in scientific thought. n experimental investigator he was seldom sur- ed for patience, resource, and accuracy, while in y of his penetrating analyses of his observations o be found the germs of ideas current even to-day. did much to clear away the scholastic under- rth which hindered scientific progress, and formu- l conditions under which scientific work should arried out in order to discover the truths of ure. It is clear from Mr. Spriggs' all too brief that a full study of Boyle's writings would be ry welcome contribution to the history of science.

ock Carvings in the Italian Alps.—In *Antiquity* une, Mr. Miles C. Burkitt discusses the origin and ose of the rock carvings on the slopes around te Bego in the Italian Maritime Alps. The only ematic study of these carvings in the neighbourhood ordighera was that made by Mr. Clarence Bicknell, beginning in the year 1897, in the following ty years made rubbings of some 15,000 carvings. carvings fall into three classes: (1) Animals; eapons and tools; (3) signs, patterns, and scenes. animals are predominantly oxen. There are ral human figures, mostly associated with ghing scenes. The drawings are nearly all con- ionalised, and the figures represented as though from above. The weapon most commonly figured e triangular dagger with a handle. The halberd so shown. As the carvings are at the head of ys leading up to Monte Bego, and this mountain important cyclonic centre, of which the peasantry recognise the importance in connexion with the her, it is suggested that the carvings may be the ession of a seasonal agricultural cult which took orm of an annual pilgrimage such as those which been perpetuated in Italy under the Church. object of the pilgrimage would be to secure her propitious for the crops and animals from the of the mountain. As regards their age, there is vidence of habitation before the period of the ngs, and though culturally all the carvings can ssigned to the Early Bronze Age, it does not sarily follow that they can be associated in time the industry of the lake dwellers. On the other , the Iron Age peoples do not appear to have trated these mountains, but the absence of any tian symbol shows that they must have been uced prior to A.D. 300.

sociation of the Tuatara Lizard with Nesting ls.—A note on some features of this curious iation between a lizard and a bird appears in the al scientific number of the *Municipal Record* ne Auckland City Corporation, issued on the occasion of the visit of the New Zealand Institute Science Congress in January last. Tuataras still live in fair numbers on eight or ten groups of islands near East Cape, and these are inhabited also by different species of petrels. In many cases the burrows of the petrels are shared by tuatara and petrel during the nesting season, while in the winter, when old and young petrels have departed for the northern hemisphere, the tuatara digs itself in at the end of the burrow to hibernate. The association as a rule is one of *laissez faire*; both petrel and tuatara, the note relates, sleep during the day, and at night, when the lizard issues to hunt nocturnal insects, the petrel also goes about its business. Occasionally the lizard may devour the solitary chick of the petrel, but often it just leaves it alone. It appears that in the first instance the burrows are made by the petrel, but the lizards are long-lived, and, surviving the birds, eventually may remain sole occupants of the tunnel.

Effect of Low Temperature on Mitosis.—F. G. Spear (*Arch. f. exp. Zellforsch.*, 7; 1928) records observations on the effect of low temperature on mitosis in tissue obtained from the choroid and sclerotic of chick embryos of 7-8 days' incubation grown in fowl plasma and chick embryo extract on coverslips each inverted over a hollow-ground slide. The cultures were placed in a cold room at 0·5° C. for four hours and then incubated at 37° C. The duration of mitosis in chick tissues at 38° C. varies from 23 to 65 minutes (Levi, W. H. and M. R. Lewis, and Strangeways); at 28° C. the process takes about twice as long (Lambert and Hanes) and at lower temperatures is further delayed or arrested. Probably those cells which are in the later stages of mitosis when the culture leaves the warm incubator for the cold room pass through to completion, those in the early stages of mitosis proceed for a time and become arrested when the temperature of the culture falls to between 10° C. and 0° C. On re-incubation after chilling, the majority of these cells resume the process of mitosis. Chilling interferes with the initiation of mitosis, and there is no evidence of the resumption of this process until after 80 minutes' incubation. From this time there is a steady increase in mitosis until a maximum is reached about the 9th hour after chilling, when the number of cells in mitosis exceeds that in the controls by 60 per cent, after which there is a gradual fall up to the 13th hour of incubation. The fall in number of cells in mitosis seen during the first 5½-hour period of incubation subsequent to chilling is almost exactly compensated by the increase during the second 5½-hour period.

Vaccination of Silkworms.—Among the diseases to which silkworms are subject and which cause considerable mortality are those known as yellowness (giallume) and flaccidity. In Parts I.-V. of the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for the current year, Dr. Domenico Carbone gives the results of experiments, made in conjunction with Signorina Elena Fortuna, on the vaccination of the silkworms with material prepared from the whole of the microflora of the diseased worms. Various preparations of vaccine made in different ways were employed and the mode of administration was either oral alone—by means of leaves immersed in the vaccine solution and then redried—or oral and cutaneous (spraying) together. The number of experiments made is as yet small, but the results, although not entirely consistent, indicate that distinct diminution in the mortality due to these two diseases

may be affected by the vaccination. The immunity appears to be specific.

Experimental Hop Drying.—The correct rate of drying hops is an important matter to the hop grower, since the colour and aroma by which the finished product is judged for brewing purposes are guaranteed only by prolonged and therefore expensive drying at a low temperature. More than twelve hours, for example, are required at temperatures below 120° F. The seventh season's work (1927) at the experimental oast of the Institute of Brewing, Paddock Wood, had as its principal object the determination of the most economical drying and storage conditions, and some interesting results are summarised by A. H. Burgess in the May issue of the Institute's *Journal* (**35**, 235; 1929). The actual (T) and minimum (M) times of drying in minutes were shown to be related to the loss of water (L) in oz. per square ft. of kiln floor, and the air speed (a) in ft. per min. by the equation $T = M + 87{\cdot}3\ L/a^{1{\cdot}047}$. M was found to depend principally on the temperature and to a less extent on a. Hops dried at above 104° F. showed a decrease in preservative properties, probably on account of a reduction in the proportion of so-called α-acid, though hops sterilised at 212° F. had higher preservative properties than the same hops dried in air at 140° F. Hops sterilised by treatment with sulphur dioxide, or dried in nitrogen at 212° F., however, showed a decrease in preservative value, and the effect of the former gas on the colour was no more marked than that produced by sulphur burnt in the ordinary way. The present type of intermittent kiln was shown by humidity measurements to produce very uneven drying, and a continuous type is considered more suitable. On the other hand, this lack of uniformity is partly compensated by diffusion of the moisture, particularly from the strigs to the bracts, during the cooling period.

The Coral Reefs of Oahu.—The island of Oahu in Hawaii is surrounded by a fringing reef and also shows fossil reefs in certain parts. Mr. J. B. Pollock publishes his researches on the nature and origin of these reefs in *Bulletin* 55 of the Bernice P. Bishop Museum, Hawaii. The fringing reef is in a state of active growth and is covered, like the fossil reefs up to 20 feet above sea-level, by coralline algæ and corals, the former predominating. Very few corals are found near the zone of breakers. The present fringing reef has developed since the last change in level of the sea, and began its growth at a depth of probably three fathoms or less. If the most abundant organism in the reef, a species of crustaceous alga, be taken as a basis for calculation, the rate of growth of the reef must be about 18 feet in 5000 years. Mr. Pollock insists that the study of these reefs gives no support to Darwin's subsidence theory. There is no barrier reef with lagoon. The fossil reefs were all formed during a time when the sea stood higher than it does at present, but there is no evidence by which to determine definitely their ages. The sea bottom around Oahu gives Mr. Pollock no evidence of a submarine shelf such as is demanded by the glacial control theory. Outside the reef the slope is gentle to a depth of 40 fathoms and then more rapid to 100 fathoms. He regards the slope of the sea floor as being very similar to that of the continental shelf.

Electron Waves.—The experiments of Drs. Davisson and Germer on the polarisation of electron waves, a preliminary account of which was published in NATURE last year (Nov. 24, p. 809) are described in detail in the May number of the *Physical Review*. The principle which they have employed is simple, being that of the Nörrenberg polariscope, with nickel crystals instead of mirrors, an 'electron gun' in place of the source of light, and a Faraday cylinde to receive the twice-reflected beam. The actua apparatus is most complicated, and consists of a elaborate metal structure which is built into a exhausted glass vessel, and so designed that there i freedom of motion between the appropriate componen parts, whilst, at the same time, currents of only som 10^{-11} ampere to the collecting cylinder can be measure with accuracy. The assembly of the apparatus is matter of some delicacy, and the planning and carry ing out of the experiments a notable achievemen The results obtained are in agreement with Pro C. G. Darwin's theoretical prediction that an initiall unpolarised beam of electrons should remain un polarised after diffraction by a grating, provided tha the forces responsible for the scattering are electri rather than magnetic in origin.

Secondary Cosmic Radiation.—It has been notice in work with the Wilson expansion apparatus tha even when very great care is taken to avoid radio active contamination, fast β-rays of uncontrolle origin occasionally appear, shooting across th chamber in almost straight lines. From the sma linear density of the ions in their trails, it is certai that these particles are of exceptionally high speed and the attractive hypothesis that they represen secondary electrons produced outside of the chambe and in its walls by the ultra-gamma cosmic radiatio has now been examined by D. Skobeltzyn (*Zeitschri für Physik*, May 11, p. 686), using the method men tioned in his recent letter to NATURE (Mar. 16, p. 411 Thirty-two trails of this type appeared on makin some six hundred exposures, and in only one instanc was the trajectory of the particle markedly affecte by the magnetic field in the chamber. The energy o the majority of the particles was not less tha 15 million electron-volts. Taken in conjunction wit the frequency with which they occur, and the fac that they have a predominantly vertical direction o motion, this leaves little room for doubt that the are secondary products of the cosmic radiation. Th exact mechanism by means of which they are produce is nevertheless not certain. They exhibit a marke tendency to occur in groups of two or three, whic are not contemplated in the usual Compton-Deby theory of the scattering of radiation, and there is als some indication that fast protons may be present, a well as the β-particles. If this can be substantiated it will be difficult to avoid the conclusion that th cosmic rays are able, directly or indirectly, to effe the disintegration of the *nucleus* of an atom.

Specific Heats at Low Temperatures.—An accoun of the determination of the specific heats of aceton methyl-, ethyl- and *n*-propyl alcohols at low tem peratures is given by S. Mitsukuri and K. Har in the *Bulletin of the Chemical Society of Japan* fo March. Temperatures down to about −110° C wer employed, and in order to overcome the difficulty o maintaining the environment of the calorimeter a constant temperature, a method was used whereb the temperature of the calorimeter surroundings wa allowed to increase at a regular rate.

Heats of Combustion of Organic Compounds.— critical survey of previous work on the heats of com bustion of organic compounds has been made b M. S. Kharasch and is published by the U.S. Burea of Standards in the *Journal of Research*, vol. 2, No. A table of 'best' values, including all the availab data, is given, together with a complete bibliography. method is described for calculating the heat of combu tion from the structural formula of the substance, an in most cases the calculated and observed values agre

thin 1 to 2 per cent, that is, within the limits of of the experimental determinations.

nganese in Foodstuffs.—The results of an in-gation of the manganese in foodstuffs and a od for its analysis are described by Newcomb Sankaran in the *Indian Journal of Medical rch*, vol. 16, No. 3. The ash of the foodstuff dissolved in nitric acid and the manganese then sed to permanganate by ammonium persulphate ie presence of silver nitrate as catalyst. The nt of permanganate was estimated by the depth loration. Manganese appears to be present in odstuffs, with the exception of oils and cane-, and a sample of oatmeal contained as much as nilligrams per kilogram. In cereals most of the anese appears to be in the outer layers of the s, and hence much of it is often removed when are prepared for use as food.

e Radiation Hypothesis of Chemical Reaction.—ermal unimolecular reactions are really photo-ical reactions in which the frequency of the ating radiation lies within the infra-red region, the thermal reaction rate should be increased xposing the system to such radiation. W. Ure R. C. Tolman have applied this test in the of the racemisation of *d*-pinene, which is known e unimolecular, by subjecting the pinene to tion of wave-lengths up to 3 μ at such a tem-ure that the thermal reaction was just appre-e. Their experiments, which are described in the *nal of the American Chemical Society* for April, that large increases in the density of radiation ese wave-lengths has no effect on the rate of nisation. The work of Lewis and Mayer, also ed out with pinene, is critically discussed, and conclusion that radiation up to wave-lengths of is inactive, is not accepted by Ure and Tolman.

acking Petroleum.—In two recent papers in the *edings of the Royal Society* (vol. 116, p. 501, ol. 120, p. 247), Prof. H. A. Wilson has developed heory of the chemical equilibrium of mixtures of ffins and unsaturated hydrocarbons, and has n that the composition of both the liquid and apour phases can be calculated approximately if emperature and pressure of the system are known. third paper, in the May issue of the *Proceedings* 6), he has now applied these results to the rtant practical problem of the 'cracking' of leum, in which the composition of an oil is ed by heating it under pressure, the product being wards fractionated. He finds good agreement een the actual course of the reactions and that cted from thermodynamical reasoning, both when ressure is sufficiently high to keep the greater of the oil in a liquid state, and when the cracking formed on the vapour, in spite of the fact that ugh it is possible to make some allowance for the ition of coke, the theory has not yet been ded to allow for the presence of naphthenes and atic hydrocarbons. Apart from its possible cations in petroleum technology, Prof. Wilson's is of great interest in that it seems to confirm iew that was expressed by Berthelot so long ago 66, that a mixture of hydrocarbons will proceed uilibrium if only it is raised to the appropriate temperature.

ctric Power in Quarries.—In the *Mining Electri-ngineer* for May there is an interesting descrip-f the Blackford quarry of the Midlothian County il. The improved methods of quarrying, and apidity with which necessary repairs for the can now be carried out, have proved a great boon to the county. The quarry is worked by an electric supply taken from the works of the Edinburgh Corporation, and transmitted at high voltage to the quarry, where it is converted to a pressure of 400 volts. The first operation in quarrying road material is to break up the rock. This is done by the ordinary methods of drilling and blasting. The broken material is separated by hand into portions larger and smaller than about five inches. The wagons containing the material are transported by an endless rope haulage to the feeding platform, where the large material is tipped into a primary crusher, and the smaller into a shaker feed. The crusher is a massive piece of machinery with manganese steel jaws capable of reducing the material to portions not greater than five inches. The output is then transported to the secondary crushing plant. A magnetic pulley is used to prevent any 'tramp' iron from passing into the crushers and possibly damaging them. The crushers are capable of producing about 50 tons per hour, the stones all being less than $2\frac{1}{2}$ inches. By suitable screens the material is graded, some of it passing to a granulator where it is further reduced. The storage bunkers have a capacity of 800 tons each, and are divided into compartments depending on the size of the graded material. Each compartment has a sliding trap-door over the loading dock so that the material can be transferred directly to the wagons.

New Steam Tables.—An interesting report entitled "Extended Steam Tables" is made by Prof. H. L. Callendar to the Institution of Mechanical Engineers. The report is from the British Electrical and Allied Industries Research Association, with the assistance of which it recently became possible to measure the total heat of both water and steam at pressures up to 4000 lb. per square inch and temperatures up to 750° F. The need for accurate knowledge of the properties of steam at high pressures and temperatures, including the critical region, has been acutely felt recently, and this is a very welcome contribution to the subject. The new data obtained are quite inconsistent with the van der Waals theory, but fall into line with the basis of the Joule-Thompson equation. A general account is given of the theory and development of an equation of the latter type with suitable constants to give a good fit over the whole range, together with a skeleton set of tables calculated from the new equation. The equation and tables are not intended to be final, but are given as a basis for discussion and comparison. The apparatus and methods of taking and reducing the observations are dealt with briefly, since they have been fully described in previous articles dealing with investigations in lower pressure regions, to all of which articles references are made. The method of analysing the observations is illustrated by a few actual examples, the analyses chosen for this purpose being those of the observations taken with the object of investigating the effect of air and other impurities on the equilibrium between steam and water. Beyond the critical point, the effect of small impurities is very pronounced and most difficult to determine, and while this obstacle has been surmounted in this instance, the possibility readily suggests itself of great difficulty in the practical use of steam at such pressures due to instability resulting from small impurities. At low pressures the values given in the tables do not differ greatly from the previously published Callendar tables, but the differences increase with the pressure and are of considerable magnitude at the highest pressures, where the new tables tend to agree more closely with the recently published Mollier tables.

The National Physical Laboratory, Teddington.

INSPECTION BY THE GENERAL BOARD.

ON Tuesday, June 18, the General Board of the National Physical Laboratory made its annual visitation. A large number of visitors, including members of scientific and technical institutions, Government departments and industrial organisations, were present, and were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board, Sir Richard Glazebrook, chairman of the Executive Committee, and the Director, Sir Joseph Petavel.

Numerous experiments were in progress.

In the Aerodynamics Department the investigation on wing flutter has been extended to include the case of tail flutter, and the research has reached a stage at which recommendations can be made for the prevention or minimisation of flutter in given cases, except at flying speeds well outside the normal range. Demonstrations of the nature of wing and tail flutter were given, together with illustrations of some methods of its prevention.

The drag on an aerofoil is closely correlated with the nature of the flow close to its surface, and an experiment was in progress to determine the points at which the flow changes from a laminar to a turbulent character around a body of good aerodynamic shape. At appropriate points on the body were fitted hot wire anemometers constructed of platinum wire a few hundredths of an inch thick. In series with the anemometer wire was the primary of a transformer, and together they formed one arm of a bridge. A definite steady temperature was attained in the platinum wire with the bridge in balance. Turbulence in the boundary layer produced rapid fluctuations in the temperature, and therefore in the current through the anemometer wire, with corresponding changes in the secondary current, which was amplified by an appropriate amplifying system.

In another experiment the velocity distribution across the boundary layer was being studied at a number of points along the median section of a Joukowski aerofoil. In order to minimise external interference a very small Pitot tube is used, and can be advanced in steps of one-thousandth of an inch from outside the wind tunnel. The mechanism for advancing the Pitot head is entirely enclosed in the aerofoil, and consists of an electromagnetically operated pawl actuating a ratchet wheel attached to a finely threaded spindle passing through the Pitot tube support.

A demonstration was also given of an extreme case of body-wing interference in an aeroplane model in which the drag of the body in the presence of the wing became negative, their combined drag thus being less than the sum of their individual drags.

In the Engineering Department a machine for making tests in tension, compression, or bending up to a maximum load of twenty-five tons was shown. The machine is fitted with a six-speed gear-box, the intervals being covered by varying the speed of the driving motor. By this means rates of travel from one-thousandth of an inch to two and one-half inches per minute can be imparted to the cross-head. Autographic records of stress and strain can be taken on a recording drum.

Of interest also was apparatus for the determination of the slip and coefficient of friction of belts under running conditions. The belt passes round two large cast-iron pulleys and the sum of the tensions in the tight and slack portions can be adjusted by means of lever mechanism attached to one of the pulleys. The difference in the two tensions is obtained by means of a torquemeter on the driving shaft. The pulley speeds are measured by a speed counter connected differentially to them. From the data so obtained the belt slip and the efficiency of the power transmission can be determined.

The investigation on the mechanism of deformation in single crystals, described last year, has been extended to include the hexagonal type such as zinc and the rhomboidal type such as antimony, and it has been confirmed that deformation occurs by slip on the basal plane. Apparatus has been devised whereby Laue photographs can be taken of a single crystal of tungsten at tensile stresses up to one hundred and four tons per square inch.

For experiments on road skidding a special motor cycle side-car has been constructed equipped with mechanism for recording the load, braking force, and force normal to the wheel, which can be set at any desired angle with the direction of motion. Records have been obtained under various climatic conditions up to speeds of about thirty miles per hour.

For the study of the deformation and fracture of metals and alloys under prolonged load at high temperatures, special apparatus has been devised in the Metallurgy Department. To enable the behaviour of the specimen to be followed during load, the surfaces must be polished and kept free from contamination. For this purpose the test-piece is enclosed in a long silica tube dipping into mercury at the bottom and communicating at the top with exhausting pumps. The mercury column which rises in the tube serves as a seal. A suitable furnace encloses the tube and specimen, temperatures of the order of 1000° C being attained. The load is applied to the lower end of the specimen by a lever and weight. In the case of specimens which are volatile *in vacuo*, a neutral atmosphere can be introduced.

Apparatus for the determination of the heat which becomes latent in wire-drawing was shown. The wire is kept in tension by suitable springs attached to pulleys which the wire traverses. The calorimeter in which the die is placed is a Dewar flask. The work done is determined from the tensions in the springs, the difference between this and the heat generated being the latent heat of plastic deformation. An electrical method is used to measure the mean extensions of the springs, platinum-iridium contacts attached to them being free to slide along platinum wires included in two bridge circuits. The arrangement of the galvanometer and potentiometer is such that the difference between the two extensions is determined directly. The calorimeter is calibrated electrically.

Specimens of alloys for high temperature tests and of special refractories, both developed in the department, were on view. Of the former, one nickel chromium-iron alloy containing proportions of carbon, silicon, and tungsten was found to have an ultimate breaking stress of thirty tons per square inch at 800° C., and at this temperature to withstand without breaking a steady load of five tons per square inch for 68 days.

In connexion with the determination of the metre in terms of wave-lengths of light, a new wave-length comparator is under construction in the Metrology Department. To minimise temperature effects the comparator is thermally insulated in a double walled enclosure and the room temperature is controlled thermostatically. In order to determine its tem-

ture accurately the invar end gauge about 1 metre , which forms the Fabry-Perot étalon, is wound n its own resistance thermometer. The air in the is heated electrically and circulated.

n interference method has also been developed neasuring the lengths of block gauges without lving the wringing of glass plates to their end sur-s. The gauge to be measured is mounted vertically ptical contact with the upper surface of a flat, zontal steel plate. The difference in height of two reflecting planes formed by the upper end of gauge and the surface of the steel plate is deter-ed in terms of light wave-lengths with reference lightly silvered glass plate supported above the ge and parallel to the steel plate.

or comparing the pitches of six-inch lengths of ing screws a screw-pitch calliper has been devised he department. The instrument rests upon the w on two inverted V's and is fitted at each end n a ball-ended projection engaging a thread. One hese is rigidly attached to the calliper, the second g attached to one end of a lever operating a dial cator.

n the Physics Department a distant-reading stance thermometer outfit embodying novel ures has been developed for work in connexion n the cold storage of food. The bridge is direct ling and embodies three dials giving readings in s of 10° F., 1° F., and 0·1° F. The switch gear is rranged that the battery current is completed so long as one of the dial knobs is depressed. each dial there is an appropriate resistance in the ery circuit sufficient to prevent violent deflection ne galvanometer needle if the bridge should be out alance when the knob is depressed.

pparatus for the determination of the latent heats iquids at various temperatures and the specific ie of refrigerants was also shown in the Heat ision. In the former the calorimeter is supported novel form of constant temperature enclosure sisting of a spiral of iron tubing cast into the walls n aluminium container. The spiral is connected refrigerating plant circulating ammonia gas, and desired temperature may be produced and main-ed constant. The heat required for evaporation alanced by a measured electrical supply. Liquids lied include sulphur dioxide, methyl chloride, and tane.

n the latter apparatus two reservoirs connected tube and stop-valve are immersed in a constant perature bath. One reservoir contains the liquid gerant to be studied and the other is connected n evacuating system. By repeated evacuations ne latter and refilling with vapour from the liquid ainer, the weight of vapour required to fill the iver can be determined, so giving the specific ume directly.

n the Sound Division apparatus for the measure-t of sound absorption of materials by reverbera-methods was demonstrated. The reverberation od of an empty room with hard walls is first deter-ed, after which a definite area of the material to ested is introduced and the period again deter-ed. From the observed reduction in the period absorption coefficient may be calculated. A valve lator and loud speaker arranged to oscillate over efinite frequency range are used to produce the nd, and a microphone, receiving set, and reflecting anometer serve to record the decrease in sound nsity on photographic paper, the time scale being n by an electrically operated tuning-fork and nic motor.

pparatus for the measurement of X-ray intensity erms of the international unit was also shown. Normally the intensity has been measured by the colour change of barium platinocyanide pastilles when exposed to a given quantity of X-ray radiation. The accuracy of this method is limited by the sensitivity of individual observers to small colour changes and by the dependence of the reaction on the wave-length. The new apparatus consists of a rectangular ionisation chamber fitted with two parallel graphite electrodes through which the X-ray beam passes, graphite being chosen as its atomic number approximates closely to that of air. The normal guard ring is used and the potential difference across the plates is sufficient to produce saturation. A string galvanometer measures the ionisation current.

In the Optics Division a bench and measuring apparatus have been constructed for the calibration of electric lamps as master-standards of total radiation. A Moll open thermopile and potentiometer system specially designed to eliminate or minimise the effects of parasitic electromotive forces are used to determine the radiation. It is possible to compare the standards directly with a suitable black-body furnace.

In the Electric Standards Division a valve generator source of low and telephonic frequencies was shown in operation. Two oscillators are used, one possessing a fixed frequency of about one hundred thousand cycles per second, while the frequency of the other is continuously variable from about ninety to one hundred thousand cycles per second. Small voltages from each oscillator are applied to the grid of a detector valve and the resulting beat tone is amplified in three stages. The output from the final stage of amplification is very constant over a frequency range of from thirty to ten thousand cycles per second, the voltage being about one hundred.

In the High Voltage Building was to be seen apparatus which has been developed for research work on behalf of the British Electrical and Allied Industries Research Association in connexion with the dielectric losses at high voltages in power transmission cables. This apparatus consists of a large parallel plate condenser and a water-tube shielded resistor, each having zero phase angle. With these the losses in cables have been measured at voltages up to two hundred thousand. Use is made of half-wave rectification of the capacity current flowing across a spark-gap in the high voltage circuit to measure the peak voltage, which is calculated from the mean value of this current, the frequency and the known capacity of the gap.

A demonstration was given of the action of a three-phase field on a dielectric. The latter, in the form of a paper cylinder free to rotate about a vertical axis, was set at the centre of a three-phase field. The ensuing rotation of the cylinder demonstrated the presence of tangential stresses on the dielectric.

In the Wireless Division sensitive apparatus has been constructed for the rapid and accurate measurement of the capacities and power factors of condensers. A substitution method is adopted employing a condenser and series resistance in a tuned circuit, the condenser under test being substituted for a standard variable condenser. High frequency oscillations are used and the results are given in terms of the capacity of the standard condenser and the values of the resistance.

Transmitting and receiving circuits have been developed for work on wave-lengths of less than twenty-five metres. A transmitter operating at two hundred watts on a wave-length between four and ten metres, and a portable loop receiver working over the same range, were shown. Of interest also was a laboratory two-valve oscillator working on a wave-length of 1·8 metres. The inductance in this consists of a small rectangular coil the sides of which are about

an inch in length, while the capacity is provided by the inter-electrode capacities of the valves.

A single loop direction finder operating on a wave-length of seven metres is capable of receiving signals at distances up to eight miles.

In the Photometry Division improvements have been made in the apparatus for investigating the effect of glare on the brightness-difference threshold, the chief new feature being automatic control of the rate of change of brightness of the test spot. The movement of the lamp producing this spot is controlled by an electric motor, the speed of which is proportional to the distance of the lamp from the focal plane of the projection lens. This ensures constant percentage increase in unit time of the brightness-difference between the test spot and the surrounding field.

Of interest also was an investigation directed towards the prevention of fading of water-colour pigments. A sufficient range of pigments to cover approximately the visible spectrum is exposed on different fabrics to sunlight and to the radiation from a carbon arc. Protection is given by plain glass and by various types of ultra-violet absorbing glass. From the results obtained it is hoped to ascertain the best conditions for minimising the fading of water colours.

In the William Froude Tank a novel method of determining the wind resistance and centre of effort of ship superstructures by measurements in water was demonstrated. The superstructure complete with funnels, masts, derricks, etc., is towed upside down in water at slow speeds. Then, since for the same value of Reynolds's number the fraction (resistance)/(length)^2 (speed)^2 (density) is the same for air and water, the resistance in air can be determined from the measured value of the resistance in water.

Jealott's Hill Research Station.

THE future of agriculture is bound up with the development of the fertiliser industry. Farming without manures, the exploitation of the natural resources of the soil, is characterised by large areas and declining yields; it is only rendered possible by cheap and abundant labour on one hand or a high degree of mechanisation on the other. The first step towards more permanent conditions and a higher level of production is usually the fixation of atmospheric nitrogen by the agency of leguminous crops, aided when necessary by the addition of phosphate and of lime. The use of animal manures follows. Then in the search for nitrogen, farmyard manure is enriched by the feeding of purchased feeding stuffs. At this stage the need for further phosphate became insistent, and we reach the level of the best British farming of the 'seventies.

In recent years in the older countries this system has been pushed one stage further by the scarcity of land, the introduction of crops which make a great demand on the soil, and the necessity of securing a high production per acre. On the lighter soils, particularly, the need for more potash makes itself felt, and for certain crops in the rotation further nitrogen is still necessary. For a time, by-product sulphate of ammonia and Chile nitrate of soda could provide the necessary nitrogen. In the War period and the years which followed, various processes of fixing atmospheric nitrogen were greatly developed, thus laying the foundation of an abundant supply of cheap nitrogenous fertilisers in all industrialised countries.

In the meantime, numerous field experiments in Great Britain and abroad showed that an increased amount of nitrogenous fertilisers could be consumed by farmers with advantage, particularly if supported by appropriate additions of phosphoric acid and potash. It was further shown that grass-land in intensively farmed countries, which hitherto had received phosphates, if it was manured at all, could also benefit from nitrogenous fertilisers under certain systems of management. The supplying of a range of nitrogenous manures suited to the varied conditions of Great Britain and the Empire, and the working out of their economical and effective use in practice, is the task which Imperial Chemical Industries, Ltd., has taken up. As the source of supply there is the huge synthetic nitrogen plant at Billingham-on-Tees, turning out as its main products sulphate of ammonia and nitro-chalk, the former being our leading source of nitrogen as regards tonnage and range of application, with almost a century of experience and experiments behind it; the latter a new product consisting of ammonium nitrate and chalk, which combines the advantages of nitric and ammonia nitrogen. There is, however, the staff and equipment at Billingham to manufacture further products as the need for them may arise; and one may expect to see in due course the production of ammonium phosphate, and by inclusion of the natural potash salts, a range of high grade mixed fertilisers similar to those which are becoming a feature of the continental market.

To develop the old and to investigate the new an expert agricultural service is a necessary complement to the producing organisation. Imperial Chemical Industries' Research Station at Jealott's Hill, near Maidenhead, which was opened on June 28, is designed to meet this need. It consists of a farm of some 440 acres, and a well-equipped laboratory containing the usual departments for the study of the many-sided problems of plant and animal nutrition.

The arable portion of the farm is devoted to experiments of modern design to test the effects of fertilisers on farm crops, with special reference to the use of I.C.I. products. In addition to the fertilisers mentioned above, ammonium chloride, urea, nitrate of lime, ammonium phosphate, and the German compound fertiliser 'nitrophoska', are being used. Experiments are also in view on the manuring of horticultural crops, a line of inquiry which has been somewhat neglected in the past but will assume greater importance in future. The grass-land is largely used for investigations and demonstrations of intensive systems of pasture management in which the use of generous applications of nitrogenous fertilisers is an essential feature.

This conversion of cheap inorganic nitrogen into the protein of young grass, and its further conversion into a saleable form by the agency of live stock, raises a series of practical and scientific problems which are being attacked energetically on the farm and in the laboratories at Jealott's Hill. The effect of the manurial treatment on the pasture itself from its botanical and chemical aspects is being worked out, the measurement of the digestibility of the resulting grass to various classes of stock is under investigation, while the question of how best to utilise the surplus which may arise in favourable seasons is being examined. At certain times of year, hay-making is uncertain and troublesome. Two alternative methods are being tested: the making of grass silage and the artificial drying of short young grass, which opens up the possibility of the production of home-grown concentrates or grass cakes. The latter process the outcome of the work of the Cambridge School

eing followed out in detail, using experimental
ng plants of various designs.
n the practical side, there are the agricultural
blems which arise when any considerable change
anagement is made. These are being studied on
farm, and as they are successfully met they are
onstrated to visiting parties of farmers. Thus,
e are demonstrations of the utilisation of in-
ively treated grass by young cattle (baby beef)
by dairy cows. In each case a food relatively
in protein is required. The economic side of
e trials and demonstrations is kept uppermost,
there is a special staff to work out and present
essential information.
Vith Jealott's Hill as a centre for direction, advice,
the examination of results, there extends a range
xperimental centres and demonstration areas in
at Britain, the Empire, and in foreign countries
re fertiliser tests are being made on practically
whole range of economic crops. In most cases
work is done in close co-operation with the
ting official agricultural institution both at home
abroad, and it is the policy of I.C.I. to make these
acts as real as possible.
early seven hundred guests representing every
nch of agriculture and its related industries were
sent on June 28 for the official opening of the
earch Station by the Right Hon. J. H. Thomas,
d Privy Seal. The weather conditions were ideal,
the arrangements for the comfort of the visitors
e admirably carried out. The importance of
cultural research in Great Britain and in the
pire, and the part which the new research station
play in this sphere, were set out by the chairman,
Right Hon. Lord Melchett, and by other directors
mperial Chemical Industries, Ltd.
he Jealott's Hill Station will take up its work
the good wishes of the other institutions already
blished in the field of agricultural research.

H. V. GARNER.

University and Educational Intelligence.

BIRMINGHAM.—At a degree congregation held on
e 29 the following degrees were conferred: D.Sc.
emistry) on Mr. E. L. Hirst; M.D. on Mr. W. D.
k and Mr. C. G. Payton. For the degree of
D. in science there were six successful candidates.

LIVERPOOL.—A further step towards the comple-
n of the School of Veterinary Science of the
iversity was taken on June 28, when the new
erinary Hospital was formally opened by Lord
ward de Walden in the presence of a representative
hering of those who have striven during the past
nty years for fuller facilities for veterinary research
the care of animals. This is the first occasion
which such an hospital is to be conducted by a
versity in Great Britain. The building is of
drangle form, and surrounds a central court with
ss roof. There is an operating theatre for large
mals, and ample accommodation has been provided
he form of animal boxes and stalls. In addition
re is a lecture theatre, and a museum, laboratory,
rating theatre, and a surgical ward have been
vided, the latter being specially designed for the
ds of small animals. There is also accommoda-
n for a resident surgeon and his staff. The institu-
n is intended primarily for research and instruction,
in all probability provision will be made for the
atment of domestic pets belonging to the poor.
R. Isherwood, lecturer in veterinary medicine
l honorary lecturer in clinical veterinary medicine and surgery, has been appointed administrator of the hospital, and will be associated with Profs. Share Jones and Gaiger in its direction.

ST. ANDREWS.—On Friday, June 28, Her Royal Highness the Duchess of York opened the new Graduation Hall, the gift of Mr. James Younger, of Mount Melville, Chancellor's Assessor in the University Court, and Mrs. Younger. The building is in North Street to the east of the College Chapel, and is capable of seating an audience of more than 1200 persons. The original designs prepared by Mr. Paul Waterhouse, who died in 1924, were carried out by his son, Mr. Michael Waterhouse. The actual cost, amounting to about £95,000, has been met entirely by Mr. and Mrs. Younger. Her Royal Highness, after declaring the Hall open and handing the deed of gift to the Vice-Chancellor, Sir James Irvine, was presented for the honorary degree of doctor of laws. Among the honorary graduates who were afterwards capped were Lord Blanesburgh of Alloa, and Profs. John Dewey of Columbia University, T. Percy Nunn of the London Day Training College, and A. E. Taylor of Edinburgh.

THE Joint Committee of the Royal Society and the University of Sheffield has appointed Dr. W. H. George to the Sorby Research Fellowship, tenable at the University of Sheffield. Dr. George will continue his work, begun at the Davy-Faraday Research Laboratory, at the Royal Institution, on X-rays and crystal structure.

APPLICATIONS are invited for the Drapers Company's research scholarship in dyeing, value £100 a year with remission of fees; the Joseph Blamires research scholarship for research in colour chemistry, value £100 a year with remission of fees; and the British Dyes research scholarship for research in colour chemistry, value £75 a year with remission of fees. Particulars and forms of application may be obtained on application to the Director of Education, Technical College, Huddersfield.

THE Air Ministry announces that six hundred aircraft apprentices, between the ages of fifteen and seventeen years, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Cranwell, near Sleaford, Lincs. They will be enlisted as the result of an open competition and of a limited competition which will be held by the Civil Service Commissioners and the Air Ministry respectively. Full information regarding the dates of the respective examinations, the methods of entry and the aircraft apprentice scheme generally can be obtained from the Royal Air Force, Gwydyr House, Whitehall, S.W.1. The scheme offers an opportunity to well-educated boys of obtaining a three years' apprentice course of a high standard.

A KING Senior Medal, consisting of a gold medal, has been founded by Mr. Sontsu G. King in memory of his parents, Mr. and Mrs. Sung-yuan Daw King, with the object of encouraging original investigations in natural history. The medal is to be awarded annually for the most meritorious work, selected by a prize committee appointed by the executive council of the Peking Society of Natural History, on the flora or fauna of China. Mr. King has also founded a King Junior Prize, consisting of a bronze medal and the sum of 20 dollars local currency, in memory of his brother, Mr. Kung-pao King, a charter member of the Peking Society of Natural History, to be awarded for the best collection of Chinese natural history objects with descriptive notes made by anyone under twenty years of age.

Calendar of Patent Records.

July 6, 1846.—One of the most common proposals for achieving perpetual motion has been to mount weights on a wheel in such a manner that they are free to move towards the periphery on the descending side of the wheel and towards the centre on the ascending side, the greater leverage thus given to those on the descending side serving, it is assumed, to produce the rotation of the wheel. James Thompson's invention, for which a patent was granted on July 6, 1846, utilises this principle to increase the power of a steam-engine, two oppositely disposed levers being fixed to the fly-wheel shaft, which are acted on by weights moved to and fro along the levers by crank motions.

July 7, 1856.—'Condy's fluid', a mixture of sodium manganates and permanganates, was the invention of Henry Bodman Condy and was patented by him on July 7, 1856.

July 7, 1884.—The first International Convention for the protection of industrial property was signed at Paris in 1883, and came into force on July 7, 1884. Its main provision allowed an inventor who had applied for a patent in any one of the signatory States to obtain a patent for the same invention in priority to other applicants in any other country of the union, protection to start from the date of the first foreign application. The International Union now comprises 42 States, including the self-governing dominions of the British Empire; Russia is the most notable exception.

July 8, 1876.—Blasting-gelatine—a mixture of nitroglycerine with 7-8 per cent of collodion gun-cotton—was invented by Alfred Nobel in 1875 and was patented by him in Sweden on July 8, 1876. The English rights were transferred under an old agreement to the Nobel Explosives Co., of Ardeer, but production of the new explosive did not start here until 1879, and large quantities were imported into Great Britain from the continent, where the manufacture had been very rapidly developed.

July 10, 1817.—The kaleidoscope was patented by David Brewster on July 10, 1817: "A new optical instrument called the kaleidoscope, for exhibiting and treating beautiful forms and patterns, of great use to all the ornamental arts—realising the idea of an ocular harpsichord".

July 12, 1799.—An invention for utilising the force of the waves of the sea was patented in France on July 12, 1799, by the Girards, father and son, of Paris. A float in the water is suspended from one end of a lever, the other end of which operates pumps, wheels, or mills. Or a boat is provided with gearing which is operated as the boat rises and falls by a rope, one end of which is anchored to the bottom of the sea and the other end weighted.

July 12, 1848.—An early electric incandescent lamp was patented by W. E. Staite on July 12, 1848, the filament being of platinum and iridium and operating in the air. Staite was also the inventor in 1846 of an arc lamp having two vertical carbons, the upper one of which was stationary and the lower one actuated by clockwork under the control of an electromagnet in the lamp circuit, so that the carbon was moved up and down as required.

July 13, 1781.—The compound steam-engine was first introduced by Jonathan Hornblower, whose patent for the invention was dated July 13, 1781. An engine was erected at the Tin Croft mine in Cornwall in 1792, but was found to give no greater efficiency than the Watt engine, and the experiment was abandoned. It was many years, in spite of its reintroduction by Wolff in 1804, before the principle of compounding was fully developed.

Societies and Academies.

LONDON.

Royal Society, June 27.—**Lord Rayleigh**: A photo electric method of measuring the light of the night sk with studies of the course of variation through th night.—**J. C. McLennan, M. W. Perrin, and H. J. Ireton**: The action of high-speed cathode rays o acetylene.—**Lord Rayleigh**: Fluorescent and pho phorescent excitation of mercury vapour by th resonance frequency and lower frequencies.—**T. Stern, B. S. Gosling, and R. H. Fowler**: Furth studies in the emission of electrons from cold metal An extension of Nordheim and Fowler's work o electronic emission from clean cold metals. It ex plains a wide range of experimental results obtaine with films of sodium (or tungsten). The normal stabl sodium film formed is mono-molecular and reduces th work function from 4·5 volts to somewhat less tha 2 volts. The currents concerned are of high density the space charge correction is negligible for the con ditions of the experiments discussed.—**A. E. H. Love** The stress produced in a semi-infinite solid by pressur on part of the boundary. The method of potentials invented by Boussinesq, is developed and applied t the case of uniform pressure over a circular area among others. The solution is also discussed arith metically with the object of throwing light on th technical question of the safety of foundations. Be neath a round pillar, there is a basin-shaped surfac possessing a roughly similar property. The form o this surface is determined. In these cases failur arises through excessive stress-difference. Tensil stress is greatest near the base of a pillar, or a corne of the base of a wall, and just outside it. It would no endanger a round pillar, but may be a cause of decide weakness if the boundary of the base of a wall or pilla presents a sharp corner.—**A. N. Shaw and H. E. Reille and R. J. Clark**: The ageing of standard cells: in creased accuracy in their use: and internationa comparisons.—**H. Quinney**: A comparison betwee the behaviour at the Ac_3 point of single crystal iro and polycrystal iron, both in the strained and un strained states.—**J. N. Pring and G. M. Westrip**: A electrometric method for the determination of ozon at high dilutions.—**C. F. Jenkin and G. D. Lehmann** High-frequency fatigue.—**J. S. Townsend and S. P MacCallum**: Ionisation by collision in monatomi gases. A discussion of some recent theories of con ductivity.—**R. C. Johnson and R. K. Asundi**: The structure of the high-pressure carbon bands and the Swan system. Both systems are due to a C_2 molecule Four new high-pressure bands have been found in the near ultra-violet, and two more in the near infra-red These, with the known bands, form a single vibrationa progression ($n' = 0$), and both systems represent transi tions to a common final state. The initial state of the high-pressure system is believed to be a *normal* $^3\Pi$ level and different in this respect from the two lower $^3\Pi$ levels, which are believed to be *inverted*.—**D. M. Newitt** Gaseous combustion at high pressures (13). The experimental data from explosions of various $2CO + O_2 + 4CO$, $2H_2 + O_2 + xN_2$ and $2H_2 + O_2 + xA$ mixtures a high initial pressures have been analysed, and mean molecular heats of nitrogen and steam have been calcu lated for the temperature range 289°—2600° to 3000° K and for carbon dioxide for the range 289° —3173° K. The results for nitrogen are in agreement with the generally accepted values, but those for steam and carbon dioxide are higher.—**R. J. Clark** On the direct determination of the electrostatic moments of molecules. Direct deflection in a rapidly varying field is used. Sodium and potassium atoms

either no permanent electric moment, or one is too small to measure. So far no polarisation ne field on these molecules has been found.—**A. R.** : On the criterion for stability of a layer of us fluid heated from below. Rayleigh gave a nematical account of the modes of instability of scous fluid heated from below with the special mption of zero tangential forces at the boundaries, found unexpectedly that the top-heavy layer of was stable until a certain temperature gradient, tive upwards, was exceeded. Jeffreys has reduced problem to the solution of a linear differential tion of the sixth order with constant coefficients, complete solution of which is now given.—**R. B.** e : The absorption coefficient for slow electrons ercury vapour.—**F. L. Usher** : A mechanism of inisation.—**H. R. Hassé** and **W. R. Cook** : The rmination of molecular forces from the viscosity gas.—**J. C. McLennan, A. B. McLay,** and **M. F. rford** : The spark spectrum of thallium (Tl III).—**A. Fisher** : Tests of significance in harmonic ysis.—**F. H. Constable** : Sulphide colours on llic copper. Spectrophotometric methods show the sequence of colours produced when a mixture ydrogen sulphide and air or oxygen acts on llic copper is a series of true interference colours. characteristic silvery colour is due to the flatness ne reflection maximum in the intensity wave-h curve.—**G. I. Taylor** : Waves and tides in the sphere.—**R. W. B. Pearse** : The ultra-violet rum of magnesium hydride II. The bands of the y-lined ultra-violet (γ) system of magnesium ide have been measured in the region λ 2560 to 40. The vibrational analysis shows that this m has no level in common with the previously n α- and β-systems. The rotational structure at characteristic of the $^1S \rightarrow {}^1S$ type of electron ition. Measurements of the isotope effect in two e bands indicate that the emitter is the diatomic cule MgH (or MgH^+), Mg having isotopes of ic weights 24, 25, and 26.—**G. Temple** : The d-order wave equations of the spinning electron. equations are obtained by a simple modification axwell's electrodynamic equations. As in Dirac's y, non-commutative properties of the operators mployed to introduce spin-correction terms into ave-equations and expressions are obtained for ge-density and current-density, together with isation and magnetisation.—**A. V. Hill** : Anaerobic val in muscle.

ysical Society, May 24.—**J. H. Vincent** : Experi-s on magnetostrictive oscillators at radio fre-cies. An account is given of the behaviour of nagnetostrictive oscillators, 6 mm. and 4·5 mm. gth, when placed in a coil in series with the main tion coil of a simple valve-maintained oscillating t. The frequency characteristic of the smaller ator is 540 kc./sec.

ne 14.—**W. Jevons** : The band spectrum of lan-um monoxide : with a preliminary note on onic band spectra of diatomic molecules. The rum has been observed from λ8700 to λ2850, and and-heads (most of them not hitherto recorded) ged into several systems.

PARIS.

ademy of Sciences, May 27.—**Ch. Lallemand** and **évot** : Slow variations of the mean level of the n the French coast. The rise in the sea-level, ed on the French coast for the last three-quarters century, is not due, as had been supposed, to a sinking of the ground, but to astronomical omena of a periodic nature. The total amplitude of the regular oscillation appears to be about 7·5 cm.—**H. Vincent** : The therapeutic results given by a new antistreptococcic serum. Detailed account of clinical results obtained with the new serum.—**André Blondel** : The powers and mutual *hormanances* of non-sinusoidal alternating currents. Suggestion of a new terminology for wattless currents.—**E. Mathias** : Contribution to the study of fulminating material. Discussion of the best means of protecting buildings against globular lightning.—**J. Neyman** : The limit of probability of hypothesis.—**Paul Dubreil** : Some complements to Nœther's theorem.—**Serge Bachvaloff** : The simultaneous deformation of two associated surfaces.—**S. Finikoff** : The congruences of Goursat.—**Georges Durand** : The construction of Cantor-Minkowski in the plane.—**Miron Nicolesco** : A theorem of Pompeiu.—**René Lagrange** : Certain functions associated with Legendre functions.—**Henri Cartan** : The growth of meromorph functions of one or more complex variables.—**J. Le Roux** : Systems of reference with apparent gravitation.—**H. Mineur** : Statistical researches on the solar apex and on the vertex of the distribution of the stellar velocities.—**Alex. Véronnet** : The electronic theory of the ether and of light. The electronic theory, extended to the ether, explains the field not mechanically but electrically. From this theory can be deduced the laws of light, magnetism, and gravitation.—**V. Bjerknes** : The equations of hydrodynamics.—**J. E. Verschaffelt** : Can the Maxwell-Clausius relation be explained without recourse to the principle of Carnot ? Critical discussion of a recent communication (*C.R.* 1929, p. 778) of V. Karpen.—**L. Brüninghaus** : The existence of a conducting state of so-called insulating liquids. Certain liquids (petrol, vaseline oil, crystallised benzene) in thicknesses of the order of 0·5 mm. show a slight conductivity, diminishing with time : this may be attributed to the presence of traces of dissolved water. But for thicknesses of the order of 10 μ a new phenomenon appears. Under a potential difference of from 50 to 110 volts, these insulating liquids suddenly acquire metallic conductivity. The possibility of a short circuit was excluded and there was no pulverisation of the metal.—**Pierre Bricout** : The efficacity of discontinuous electrostatic screens.—**G. Siadbei** : A new use for piezo-electric quartz. An application to chronometry.—**Edmond Rouelle** : The characteristics and stability of ferroresonant circuits (oscillating circuits admitting of coils with iron cores).—**Jean Thibaud** : The possible existence of important exceptions to the principle of selection relative to the total quantic number. The N spectrum of thorium.—**A. Canaud** : The electrolysis of water with alternating current. The hydrogen produced is taken as a measure of the electrolysis. The results of experiments with solutions of potassium, calcium, magnesium, and sodium sulphates are given.—**A. Roux** and **J. Cournot** : The study by means of the X-rays of the internal transformations of the silver-zinc alloys. The effects of annealing, tempering, and reheating after tempering were specially studied : the general conclusions given in an earlier communication, based on physical and micrographic measurements, were confirmed.—**S. Rosenblum** : The fine structure of the magnetic spectrum of the α-rays of thorium C. Use was made in these experiments of the large electromagnet of the Academy of Sciences giving a magnetic field of the order of 36,000 gauss.—**M. Prettre** and **P. Laffitte** : The temperatures of ignition of mixtures of carbon monoxide and air. The precautions taken were the same as those described in a previous paper for mixtures of hydrogen and air. The ignition temperature is not modified by the presence of small proportions of residual burnt gases, but is lowered to

a marked extent by water vapour.—**J. Bougault** and **J. Leboucq**: The action of heat on the allophanic amides. The decomposition by heat (200°-210° C.) of the allophanic amides derived from amines of the aniline type gives ammonia, cyanuric acid, and a symmetrical urea. The allophanates derived from hydrazines behave differently, there is no formation of cyanuric acid, ammonia is produced and there is condensation to a urazol.—**R. Bousset**: The problem of asymmetric synthesis.—**Lespieau** and **Journaud**: 1 : 6-Heptadiine and 1 : 8-nonadiine. These two hydrocarbons are produced by the interaction at ordinary pressure of the sodium derivative of acetylene and trimethylene bromide and pentamethylene bromide respectively. The physical and chemical properties of the two hydrocarbons are given.—**Mme. Pierre Billon-Bardon**: The reduction of diphenylglycidic ether by means of sodium and absolute alcohol.—**Henri Moureu**: The tautomerism of the α-diketones: Study of the states of equilibrium. Methylbenzylglyoxal can be obtained in two tautomeric forms differing markedly in their refractive indices. Starting with either of these, the equilibrium in the presence of a catalyst can be studied by means of the refractive index. The results of the experiments, shown graphically, prove that the same equilibrium point is reached whichever isomer be taken.—**A. Leulier** and **Y. Dreyfuss**: The bromination of 1 : 4-aminophenylarsinic acid.—**R. Fosse, A. Brunel,** and **P. De Graeve**: The quantitative biochemical analysis of allantoin in the presence of urea. Hydrolysis is carried out by means of *Soja hispida*, in presence of ammonium carbonate. The urease destroys the urea and the allantoinase converts the allantoin into allantoic acid.—**Edgar Aubert de la Rue**: The existence of agate and of Iceland spar in the Kerguelen Archipelago.—**Jacques Bourcart** and **Guy Le Villain**: The Acadian of the Moroccan Antiatlas.—**A. Demay**: The Moldanubian (Hercynian chain).—**A. Perrier**: The presence of certain thermophile fungi in farmyard manure and in organic matter undergoing decomposition. A fungus with optimum temperature of growth 40° C. which resists a prolonged exposure to 55° C. is termed thermo-tolerant, reserving the word thermophile for moulds the optimum culture temperature of which is above 50° C. One such mould has been isolated with an optimum culture temperature of 57°-60° C. and resisting several hours' exposure to 72° C.—**V. Ghimpu**: Contribution to the chromosome study of the Acacia.—**G. Mangenot**: The so-called phenomena of aggregation and the arrangement of the vacuoles in conducting cells.—**A. Sartory, R. Sartory,** and **J. Meyer**: A disease of the melon (*Citrullus vulgaris*) caused by a Fusarium and a colour-producing bacterium.—**R. Bonnet** and **Tchang-Hyao-Tchi**: Overfeeding. Experiments on giving a considerable excess over the normal food ration to the rabbit and the pigeon. It was shown that the alimentary canal acted as a regulator of the energy distribution.—**Emile F. Terroine** and **P. Danmanville**: The formation of creatine at the expense of proteid substances.—**Michel Polonovski** and **René Hazard**: The comparative cardiovascular actions of two isomers: tropanol and pseudotropanol.—**A. Fessard** and **H. Laugier**: The form of the electromyogram of voluntary contraction. Oscillographic records.—**Robert Faillie** and **Martinot Lagarde**: Study of the influence of lighting on the precision of movements in the course of professional work. Three different tests were applied to five subjects, and the mean results are given as curves. These show that for feeble illumination a small increase in the light intensity produces a marked improvement in the precision of the movements.—**H. Colin** and **P. Ricard**: Some properties of laminarine from the Laminaria.—**Paul Cristol**: The interpretation of the values for the alkaline reserve of the blood plasma in the course of the keto-acidoses. In the cases of keto-acidosis, normal or high alkaline reserve frequently met with in diabetes, should be regarded as results due to defective technique; the accumulation of acetylacetic acid in the blood causes errors in the analytical method of Van Slyke.—**J. Vellard** and **Miguelote Vianna**: Modifications of the blood coagulation in yellow fever: their importance for the early diagnosis.—**A. Saenz**: The transplacental infection of the guinea-pig by the ictero-hæmorrhagiae spirochæte.

COPENHAGEN.

Royal Danish Academy of Science and Letters

Jan. 25.—**C. Wesenberg-Lund**: Contributions to the biology of *Leukochloridium paradoxum*. This peculiar Trematod larva, living in *Succinea putris*, has been studied for four years, partly in Nature and partly in cultures, some of which are more than four years old.

Feb. 8.—**P. O. Pedersen**: Long retarded echo signals. Discussion of the possibility of obtaining long retarded echo signals of the propagation of radio waves within the terrestrical atmosphere, or by reflection from or by propagation along ionisation bands outside this atmosphere.

Feb. 22.—**Ojvind Winge**: The nature of the sex chromosomes in *Humulus*. The male plant of *Humulus Japonicus* has three X-chromosomes, while the female has two. The difference between the two sexes, thus, is of quantitive nature. In *H. lupulus* the male has one X- and one Y- and the female two X-chromosomes, the Y-chromosomes of the male plant being homologous with the two X-chromosomes of *H. Japonicus*.

Mar. 8.—**Elis Strömgren**: Some classes of orbits in the restricted problem of three bodies (problème restreint). In 1889 and 1892 the Danish Academy set two prize questions, which resulted in the first attempt (v. Haerdtl and Burrau) to solve with the aid of numerical integration such special cases of the problem of three bodies as are not pure problems of perturbation. In 1897 G. H. Darwin published his well-known paper "Periodic Orbits", in which some classes of periodic orbits in the special problem, the "Problème restreint", were studied. In 1913 the problem was again attacked at the Copenhagen Observatory, and the programme—the study of all simple periodic orbits in the problème restreint—has now been carried through. The present paper gives the numerical results for some of the classes of orbits. The whole numerical material is to be published.

Mar. 22.—**Harald Bohr und Börge Jessen**: The distribution of the Riemann ζ-function (1).—**C. Ostenfeld**: A fertile interspecific hybrid in the genus *Polemonium*. *P. mexicanum* and *P. pauciflorum* are two Mexican species, the former rather a slender plant with short blue corollas and transparent tube about 3·5 mm. in length, the latter a coarser plant with fewer and larger flowers, yellowish corolla with reddish tinge and tube about 30 mm. long. *P. mexicanum* ♀ × *P. pauciflorum* ♂ gives an intermediate and uniform F_1, which splits in F_2 and F_3 and is fertile. The reciprocal cross fails, probably because the pollen of *P. mexicanum* is not able to grow down the stigma of *P. pauciflorum* to its ovary.

April 19.—**L. Kolderup Rosenvinge**: Reproduction in the Danish species of *Phyllophora*. The nemathecium of *Phyllophora Brodiæi* does not belong to a parasite (*Actinococcus*), and it is not an organ of the *Phyllophora*-plant; it arises on a sporophyte developing in the sexual shoots from the auxilia

f a procarp, breaks through the surface of the and produces nemathecia. On germination, etraspores of the latter give rise to young plants *Phyllophora*. The nemathecia of *Phyllophora* s are true organs of the species.

y 5.—**C. H. Ostenfeld**: The species of larch x) and their geographical distribution. All the es are found on the northern hemisphere and are, ule, mountain plants; towards the north some of occur at the sea-level. Three of the ten species in North America, the others in Eurasia. Most em have restricted areas of occurrence; only *irica*, *L. dahurica*, and *L. laricina* are widespread. distribution of the various species is given.

GENEVA.

ciety of Physics and Natural History, Mar. 21.—. Gutzeit and Ch. Devaud: A new automatic ratus for titration. The apparatus is based on act that the potentiometric curve of the liquid hich the reaction takes place presents a sharp num at the neutral point, in the case of a strong and a strong base. The arrangement, which also des automatic filling of the graduated burette, ch that the titration is automatically stopped at neutral point.—**E. Briner, P. Schnorf, and R.** r: The ozonation of the gaseous unsaturated ocarbons. The authors have specially studied the ation of those unsaturated hydrocarbons (ethylene, ylene, butylene), which are present in industrial (lighting gas, coke oven gas, gas from oil king). These substances have been submitted to isation, either in solution at a low temperature, the view of the production and study of the ides, or in the diluted gaseous state in the presence ore or less steam, which removes all danger of sion. The yields recorded for the utilisation of e and these hydrocarbons are sufficiently high to a technical interest to the problem studied.—**Parejas**: Geological observations in Corsica (4). ils of the Lias of Corte and the autochtone mulitic of Lozari. The author notes the presence e "brèche du Télégraphe" of Corte of limestone s associated with carbonaceous deposits. These s are identical with those of the zoned limestones he middle Lias of the Chamonix region. The chtone Lutecian of Lozari extends to the north he sea; it is there represented by a coarse grit aining *Nummulites perforatus* and *Discocyclina iaci*.—**E. Rod and G. Tiercy**: The eclipse of the of Nov. 1, 1929, at Geneva. The times of first last contact have been calculated graphically; rst contact will take place at 11.16, Geneva civil the last contact at 13.8. The middle of the se will be at 12.12. At this time 0·18 of the sun's eter will be covered by the moon. Hence at va the eclipse will not be very noticeable.—ercy: Where astronomers and navigators do not ar to have been happy in the choice of a term. author recalls that astronomers and navigators consider the terms 'correction' and 'rate' of a clock as having the same meaning. In y 'correction' and 'rate' have opposite signs, e the word rate (*état*) has the usual signification to it in the ordinary language of business, ce, physics, etc. This confusion appears to arise the fact that astronomers have called the *marche* hronometer the difference between two successive ctions (correction$_1$ − correction$_2$), whilst in ordin-anguage the course of any enterprise is the ence between two successive rates (rate$_1$ − rate$_2$); latter mode of expression is that generally oyed by clockmakers.

MELBOURNE.

Royal Society, April 11.—**C. H. Ostenfeld**: A list of Australian sea-grasses. As a result of the examination of the National herbaria of New South Wales and Victoria and of some recent collections from the eastern States, several interesting additions to the knowledge of the distribution of the sea-grass flora of Australia are listed.—**Isabel C. Cookson**: An account of a crown rot of English walnut trees in Victoria. A crown rot of English walnuts has occurred spasmodically for some years in the north-eastern district of Victoria, the casual organism has been found to be a species of *Phytophthora*, compared by the writer with *P. parasitica* Dastur. It is an intercellular parasite occurring in the phlœm and cambial regions, causing the death of these tissues, and a subsequent separation of the wood and bark. The parasite has been isolated in pure culture, and its life history followed. When inoculated into seedling walnuts, death has resulted, and from their dead tissues the fungus has been re-isolated.

Official Publications Received.

BRITISH.

Wigan and District Mining and Technical College. Opening of Extension by the Rt. Hon. the Viscount Chelmsford, 13th June 1929. Pp. 14+9 plates. (Wigan.)

Journal of the Indian Institute of Science. Vol. 12A, Part 6: i. A Study of the Symbiotic Fungus from the Mysore Lac Insect, by M. Sreenivasaya and S. Mahdihassan; ii. The Golgi Apparatus of Free-living Protozoa, by H. S. Madhava Rao. Pp. 69-77 + 3 plates. (Bangalore.) 12 annas.

University of Sheffield. Experimental Researches and Reports published by the Department of Glass Technology. Vol. 11, 1928. Pp. iii+203. (Sheffield.)

Northamptonshire Education Committee. Land Utilization Map of the County of Northampton: prepared from a Parish Survey on the Six-Inch Scale, carried out by the Pupils of the Public Secondary and Elementary Schools of the County, under the supervision of their Teachers. E. E. Field, Controller of the Survey. Scale of One Inch to One Statute Mile. In 3 Sheets. 33½ in. × 25½ in. (Northampton: County Education Offices.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 15, Part 2, May 20th. Pp. 73-168 + plates 21-34. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 2.50 rupees.

Malaria in Forest Areas. By Lieut.-Col. J. A. S. Phillips. Pp. 26. (Calcutta: Government of India Central Publication Branch.) 2 annas; 3*d*.

Transactions of the Mining and Geological Institute of India. Vol. 23, Part 2, May. Pp. 91-194+plates 2-10. (Calcutta.) 2.8 rupees.

Mining and Geological Institute of India. Member List, 1929. Pp. 26. (Calcutta.)

The Indian Forest Records. Silvicultural Series, Vol. 13, Part 9: Commercial Timber (Katha) and Heartwood Volume Tables for Khair (Acacia Catechu, Willd.) in North India. By H. G. Champion, Ishwar Das Mahendru and Parma Nand Suri. Pp. 33+2 plates. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1*s*. 6*d*.

Administration Report of the Marine Biologist for 1927. Pp. 27. (Colombo: Government Record Office.) 65 cents.

Administration Report of the Director of the Colombo Museum for 1927. Pp. 35+9 plates. (Colombo: Government Record Office.) 1 rupee.

Loughborough College, Leicestershire. Calendar, Session 1929-30. Pp. xiv+234+75 plates. (Loughborough.) 2*s*. 6*d*. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 5, May. Abstracts Nos. 825-1025. Pp. v+173-206. (London: H.M. Stationery Office.) 9*d*. net.

University of Cambridge: Department of Agriculture. Animal Nutrition Research Institute. First Report on the East Anglian Pig Recording Scheme. By H. R. Davidson and A. N. Duckham. Pp. 48. (Cambridge.) 1*s*. net.

Ventilation Conditions, Normal and Abnormal: and their Investigation. By Robert C. Frederick. Pp. 36. (London: Institute of Chemistry.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 12: A Study of the Effect of Diurnal Periodicity upon Plant Growth. By George Redington. Pp. 247-272+2 plates. 4*s*. Vol. 56, Part 2, No. 13: Jurassic and Kainozoic Corals from Somaliland. By Mary H. Latham. Pp. 273-290+2 plates. 3*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 1. Pp. 23. Part 2. Pp. 25-39. Part 3. Pp. 41-59. Part 4. Pp. 61-98. Part 5. Pp. 99-140. Part 6. Pp. 141-177. Part 7. Pp. 179-210. Part 8. Pp. 211-258. Part 9. Pp. 259-306+1 plate. Part 10. Pp. 307-351. Part 11. Pp. 35. Part 12. Pp. 37-112. Part 13. Pp. 113-173. Part 14. Pp. 175-222. (Trinidad, B.W.I.: Government Printing Office.)

Journal of the Chemical Society: containing Papers communicated to the Society. June. Pp. iv+1109-1385+viii. (London.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1201 (E. 29): On the Stiffness of Crankshafts. By H. Constant. (I.C.E. 670; T.V.C. 46; Final revise.) Pp. 16+8 plates. 1s. net. No. 1213 (Ae. 372): Wind Tunnel Tests of Aerofoils with Pilot Planes. By F. B. Bradfield and K. W. Clark. (T. 2717.) Pp. 26+10 plates. 1s. 3d. net. (London: H.M. Stationery Office.)

FOREIGN.

Contributions to Embryology. Vol. 20, Nos. 109-117: Early Stages in the Development of Pig Embryos, from the Period of Initial Cell Cleavage to the Time of the Appearance of Limb-Buds, by C. H. Heuser and G. L. Streeter; The Development of the Meninges in Amphibia, a Study of Normal and Experimental Animals, by Louis B. Flexner; On the Placentation of Primates, with a Consideration of the Phylogeny of the Placenta, by George B. Wislocki; A Well-preserved Human Embryo of 10 Somites, by George W. Corner; The Topographic History of the Volar Pads (walking Pads; *Tastballen*) in the Human Embryo, by H. Cummins; A Correlated Study of the Development of Reflex Activity in Fetal and Young Kittens and the Myelinization of Tracts in the Nervous System, by Orthello R. Langworthy; The Effect of various Solutions and Salts upon the Pulsation Rate of Isolated Hearts from Young Chick Embryos, by Warren H. Lewis; Macrophages and other Cells of the Deep Fascia of the Thigh of the Rat, by Warren H. Lewis; The Technique of measuring the Outer Body of Human Fetuses and of Primates in General, by Adolph H. Schultz. Pp. iii+257+52 plates. (Washington, D.C.: Carnegie Institution.) 5.50 dollars.

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 63: Fortsetzung und Abschluss der Librationen um L_2 und L_3 im restringierten Dreikörperproblem (Problème Restreint). Von Elis Strömgren. Pp. 46+1 tafel. (København.)

Forty-third Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1925-1926. With Accompanying Papers—The Osage Tribe: Two Versions of the Child-naming Rite, by Francis La Flesche; Wawenock Myth Texts from Maine, by Frank G. Speck; Native Tribes and Dialects of Connecticut, a Mohegan-Pequot Diary, by Frank G. Speck; Picuris Children's Stories, by John P. Harrington and Helen H. Roberts; Iroquoian Cosmology, Second Part, by J. N. B. Hewitt. Pp. vii+828+44 plates. (Washington, D.C.: Government Printing Office.) 2.75 dollars.

Proceedings of the American Academy of Arts and Sciences. Vol. 63, No. 12: Records of Meetings, 1927-1928; Biographical Notices; Officers and Committees for 1928-1929; List of the Fellows, Associates and Foreign Honorary Members; Statutes and Standing Votes; Rumford Premium; Index. Pp. 439-524+iv. (Boston, Mass.) 50 cents.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 56: Whales and Plankton in the North Atlantic; a Contribution to the Work of the Whaling Committee and of the North Eastern Area Committee. Pp. vi +123+26+29+70+50+112+57+84. (Copenhague: Andr. Fred. Høst et fils.) 21.50 kr.

Proceedings of the United States National Museum. Vol. 73, Art. 20: The Florida Tree Snails of the Genus Liguus. By Charles Torrey Simpson. (No. 2741.) Pp. 44+4 plates. (Washington, D.C.: Government Printing Office.)

United States Department of Agriculture. Technical Bulletin No. 95: The Meal Worms. By R. T. Cotton; with Technical Descriptions of the Mature Larvae, by R. A. St. George. Pp. 38. (Washington, D.C.: Government Printing Office.) 10 cents.

CATALOGUES.

Catalogue of Books on Mathematics, Physics, Astronomy, History and Method of Science. Pp. 28. (London: H. K. Lewis and Co., Ltd.)

Catalogue of Books on Botany, Zoology, Agriculture and Geology. Pp. 44. (London: H. K. Lewis and Co., Ltd.)

New and Recent Publications. Pp. 8. (London: Williams and Norgate, Ltd.)

Diary of Societies.

FRIDAY, JULY 5.

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association), at 8.30 A.M.—Visit to Liverpool to see the Work in connexion with the Mersey Tunnel.

OVERHEAD LINES ASSOCIATION, at 12.15 P.M.—Visit to the Mid-Cheshire Electricity Supply Company.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College, Gower Street), at 7.30.—Christopher T. A. Gaster: Chalk Zones in the Neighbourhood of Shoreham, Brighton, and Newhaven, Sussex. —H. G. Smith: Some Features of Lamprophyres, near Sedbergh, Yorkshire.

SATURDAY, JULY 6.

PHYSICAL SOCIETY (at the University, Birmingham), at 3 P.M.—S. W. J. Smith and A. A. Dee: The Magnetic Analysis of Steels.—T. L. Ibbs and K. E. Grew: Thermal Diffusion at Low Temperatures.—G. Barlow and H. B. Keene: The Damping of Vibrations in Steel Tuning Forks and its Variation with Temperature.—J. Young: The Crystal Structure of Some Carbohydrates.—M. C. Johnson: Note on the Origin of Certain Interatomic Forces.

PHYSIOLOGICAL SOCIETY (in Physiology Laboratory, Oxford), at 3.30.—H. V. Horton: The Reversible Loss of Excitability in Isolated Amphibian Voluntary Muscle.—C. W. Carter and A. N. Drury: Heart Block in Rice-fed Pigeons.—Samson Wright and H. A. Bulman: Physiological Action of X-Rays.—G. P. Crowden and E. Ogden: The Effect of Adrenaline on the Non-protein Nitrogen in the Blood of Decerebrate Cats.—G. Ekehorn: Some Observations on the Concentration of Glomerular Fluid.—Prof. H. E. Roaf: Visual Acuity with Light of Short-wave Lengths.—Prof. R. A. Peters: Observatio upon the Oxygen Consumption of *Colpidium colpodi*.—Demonstration —S. Cooper and J. C. Eccles: Isometrically Recorded Motor Respons in a Mammalian Preparation.—H. M. Carleton: Some Recent Metho in General Histology (Microscopes).—Dr. J. F. Fulton and E. G. Liddell: Chronic Decerebellate Animals.—J. C. Eccles and Sir C. Sherrington: Reflex Summation.—J. C. Eccles: Fluid Electrod suitable for the Mammalian Preparation.—T. Lewis: Standard Colou for estimating Cyanosis in Skin.

MONDAY, JULY 8.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual Gener Meeting) (at Municipal College of Technology, Manchester) (and July 9 to 13).

TUESDAY, JULY 9.

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10.15 A.M.—Annu General Meeting.—Dr. A. D. Little: Science and Labour.

SOCIETY FOR THE STUDY OF INEBRIETY (at 11 Chandos Street, W.), at 4. W. McAdam Eccles: Some Gaps in the Study of Inebriety (Presidenti Address).—Sir William Willcox and others: Discussion on The Tox Effects of Methylated Spirits and Impure Forms of Alcohol.

WEDNESDAY, JULY 10.

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 A.M.—Annu Meeting.—Prof. T. H. Pear: The Human Factor in Industry.—Dr. A. Little: Process Development.

INSTITUTION OF MINING ENGINEERS (at University College, Nottingham), 11 A.M.—General Meeting.—Dr. W. Hancock, A. G. R. Whitehous and Dr. J. S. Haldane: The Salts lost by Sweating owing to High Ai temperatures (Sixteenth Report to the Committee on The Control Atmospheric Conditions in Hot and Deep Mines).—Dr. J. S. Haldan Work of the Committee of the Institution of Mining Engineers The Control of Atmospheric Conditions in Hot and Deep Mines. The following papers will be submitted for further discussion: W. S. Cooke and I. C. F. Statham: The Flow of Air at Bends and Straight Airways (Sixth Report of the Midland Institute Committ on the Ventilation of Mines).—Dr. T. David Jones: Spontaneous Co bustion in North Staffordshire. Part II. A Record of Analyses Air-samples taken during the Combating of a Fire.—Dr. T. F. Wal Electro-magnetic Testing of Wire Ropes.—2.15.—The General Meeti will be resumed.—3.30.—The General Meeting will be closed.

TUESDAY, JULY 16.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section).—Visit to t Works of Messrs. J. S. Fry and Sons, Ltd., at Somerdale, near Bristo

PUBLIC LECTURE.

TUESDAY, JULY 16.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Sir Thom Lewis: Observations Relating to the Mechanism of Raynaud Disease (Victor Horsley Memorial Lecture).

CONFERENCES.

JULY 10 TO 12.

ELECTRICAL ASSOCIATION FOR WOMEN (at North-East Coast Exhibitio Newcastle-upon-Tyne).—Fourth Annual Conference.

JULY 12 TO 14.

MIND ASSOCIATION (Annual Meeting) (jointly with Aristotelian Societ (at University College, Nottingham).

Friday, July 12, at 8 P.M.—Prof. F. Granger: Probability and Paradox.

Saturday, July 13, at 10 A.M.—Prof. G. E. Moore and H. W. B. Josep Indirect Knowledge.

At 2.—Prof. J. Laird, C. E. M. Joad, and Miss L. S. Stebbing: T Present Position of Realism.

At 8 P.M.—J. D. Mabbott, H. H. Price, and G. Ryle: Negation.

Sunday, July 14, at 2.—Prof. G. Dawes Hicks, Prof. B. Edgell, and Pr G. C. Field: Immediate Experience.

At 8 P.M.—Address.

JULY 13 TO 20.

ROYAL SANITARY INSTITUTE (at Sheffield).

In Sections devoted to Preventive Medicine, Architecture and Engi eering, Maternity and Child Welfare (including School Hygiene), Hygie of Food, Hygiene in Industry, Veterinary Hygiene, Representatives Sanitary Authorities, National Health Insurance Services, Medic Officers of Health, Engineers and Surveyors, Sanitary Inspecto Health Visitors (including Personal and Domestic Hygiene).

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Mineralogy at Cambridge.

THE position of mineralogy in the studies of the University of Cambridge is the subject of a report by a syndicate appointed by a Grace of the Senate dated May 12, 1928, in accordance with a recommendation made on the election, for a term of five years, of the present professor of mineralogy in 1926. The Syndicate held five meetings, at some of which the professor of mineralogy was present by invitation. The members also had before them a memorandum on the history and present position of the Department by the professor of mineralogy (published as an appendix to the report), and a memorandum on the study of structural crystallography in Great Britain and on the Continent prepared by the University lecturer in that subject. The University reader in petrology was a member of the Syndicate. The main recommendations which have been put forward were reported in a note in NATURE of May 18, p. 780.

The foundation of the Woodwardian professorship provided for the teaching and development of mineralogy as well as geology, but apparently not to the satisfaction of a great enthusiast, Edward Daniel Clarke, at whose instance the present chair of mineralogy was founded in 1808. This originated the separation of geology and mineralogy, which resulted in their representation as independent subjects in the Tripos. Under Clarke's successors, however, crystallography became the main subject taught by the professors of mineralogy. Petrology was practically ignored, and when the study of thin sections of rocks with the polarizing microscope opened up great possibilities in this branch of the science, it was left to the department of geology to develop the new method. Thus an important part of mineralogy came again under the Woodwardian professor and has remained separated from the department of mineralogy. This separation, the Syndicate truly remarks, has adversely affected both studies.

More recently, the great advance in the development of crystallography due to the X-ray analysis of crystal structure has made crystallography still more dominant in the department of mineralogy and further accentuated its separation from petrology and economic mineralogy. The Syndicate believes that the future development of crystallography "lies mainly in fields bordering upon both physics and chemistry". It is convinced that crystallography and mineralogy (and petrology) cannot be adequately developed in one

department, but it does not think that they can be separately catered for in existing departments. It accordingly recommends a new grouping of the subjects, for which the department of mineralogy is to be replaced by two departments, crystallography being taught in one, and mineralogy and petrology in the other. It is recommended that the department of mineralogy and petrology should be in "the closest possible relation with the department of geology" and that "the teaching of such crystallography and crystal physics as is required by students of mineralogy and petrology should be provided by the department of crystallography". The successful carrying out of these particular recommendations will depend mainly on the cordial co-operation of the three professors concerned. As regards the staffing of the two departments, the minimum establishment proposed—a professor, lecturer, and demonstrator in each—is actually less than the number at present engaged in teaching mineralogy, crystallography, and petrology in the University. The only innovation proposed is the foundation of a professorship in place of the post at present occupied by the University reader in petrology.

For the success of the new departments the Syndicate thinks it essential that the subjects taught in both shall be separate subjects in Part I. of the Natural Sciences Tripos. These separate subjects are, however, not regarded as of sufficient importance to rank equally with the existing subjects in that examination, yet they are too important to be crowded into the already overburdened curriculum of geology, physics, and chemistry. The solution offered is to create 'half-subjects'. Under this scheme crystallography, the scope of which is outlined, is to be an independent subject but to carry a smaller maximum of marks than the existing subjects: mineralogy and petrology either to be treated similarly or—at the students' option—to be allowed to be an alternative to palæontology in the existing subject of geology. Thus a student offering chemistry and physics could take crystallography without mineralogy, while students offering geology could omit palæontology and take mineralogy and petrology "and such crystallography and crystal physics as is required", or they could include palæontology and take both mineralogy and petrology and also crystallography, and one (or more) of the existing subjects.

Finally, the Syndicate has considered accommodation. The creation of an additional department demands a new building, and the recommendation is to build new laboratories and a museum f mineralogy and petrology adjoining and commun cating with the Sedgwick Museum. Crystall graphy could then be adequately developed in t rooms at present occupied by mineralogy. Th would involve considerable capital expenditur and, in a note to the report, the Financial Boa points out that this "could only be provided at t expense of existing University activities". It ma be thought that in recommending a plan t adoption of which depends on the provision of new building, the Syndicate has doomed its repo to rejection. But the memorandum on accor modation submitted by the professor of mineralog and the remarks of the Syndicate on the lack laboratories for the study of petrology in the Sed wick Museum, are convincing proof that the prese accommodation is lamentably inadequate and u worthy of the University. Proper accommodati to allow the development of crystallograph mineralogy, and petrology has been an urgent ne for the past ten years, and the Syndicate has do good service by bringing this need prominent to the notice of the University.

If the means to meet this need cannot be foun the main recommendations of the Syndicate f the creation of two departments will inevitably postponed. There would remain the possibility the suggested changes in the Natural Scienc Tripos, which do not actually necessitate t splitting up of the present department of mine alogy. The introduction of these changes mig be sufficient to effect that close co-operation b tween mineralogy and geology which the Syn cate desires, and then, as is remarked, "the fa that [mineralogy and petrology] are taught in sep rate departments might be no more than inconvenience". With suitable modifications the scheme of lectures, students of physics a chemistry could take crystallography as a su ject without the necessity of learning descripti mineralogy.

The report was discussed during last term by t appropriate Boards in the University, and t results of their deliberations will be awaited wi interest. The adoption of a definite policy wi regard to mineralogy cannot long be postpone as any changes decided on must take effe from 1931, when the chair of mineralogy will vacated by the present professor, who succeed W. J. Lewis in 1926 after thirty-one years' voted service to the department over which two immediate predecessors had ruled for alm a century.

Industrial Catalysis.

tic Processes in Applied Chemistry. By f. T. P. Hilditch. (Monographs on Applied mistry, Vol. 2.) Pp. xx + 360. (London: pman and Hall, Ltd., 1929.) 16*s.* net.

he field of fiction it is usual to find an occa- onal volume in publishers' announcements ed as the book of the year. Such title might, r opinion, be applied with justice to Prof. ch's latest production in the field of chem- Eminently readable, lucid, accurate, and ritative, and in addition well presented by the her, it comes near to realising our ideal of an advanced text-book should be, having in always that it is written to promote the ation of science in industry.

ough the recognition of catalytic action is more a century old, it is only during the last thirty ty years that the subject has received detailed , whilst its present status as the fashionable f applied chemistry is only a post-War growth. d, as Hilditch points out, until about 1920–25, was a distinct conflict of opinion as to the anism by which a solid catalyst effected cal changes in solids or liquids. The rival were the physical, which assumes the property centrating gases in a layer at solid surfaces, e chemical or intermediate compound theory. t the latter is generally accepted, there is, as s, truth in both theories, and to-day the ists have come to the conclusion that the tion processes concerned in catalysis are ioned by forces indistinguishable from chemi- finity and are mainly concerned with uni- ular layers. At the same time, the chemists come to appreciate that an association of the ic molecules with the solid catalyst occurs, is at least equal in general character to, for ple, the association between hydrogen and a st.

is the process preparatory to the chemical e is now fully understood and there remains vestigate the next stage, how the energy ary to effect the change is applied.

book starts with a classified list of processes f products, making easy reference for those sted in a particular reaction. After a brief on the general development, there comes a lear and concise chapter on the theoretical s of catalysis at solid surfaces, which goes on l with catalyst poisons and catalyst stimu- and is followed by a special section on the of enzymes, the study of which has done much to promote the understanding of catalytic action.

The more technical section, after an introductory chapter, deals in turn with the various industrial applications of the principles of catalysis. Necessarily, the reference to any one process is brief, but it is fully adequate to cover the principles and special problems involved, and the description is all the better for being concise and not cumbered by lengthy extracts from patent specifications, which, as we are at last beginning to learn, are far from being a model of scientific literature or accuracy.

Amongst the subjects considered are the production of hydrogen, methane, methyl alcohol, etc., from water gas, and the synthesis of ammonia, cyanamide and urea, achievements which have resulted in the erection of plants the capital cost of which runs into tens of millions and will change the whole future of agriculture. The conversion of ammonia into nitric acid, by means of platinum or ferric oxide plus bismuth catalysts, will soon make the older methods for the manufacture of this acid obsolete, and cheap nitric acid may have much wider application than at present.

Contact sulphuric acid is already an old catalytic industry, but there is no end to invention in this field. We pass over chlorine manufacture and coal gas purification to the new field of synthetic organic aldehydes and ketones obtained by the dehydrogenation of alcohols. Such products are not only valuable solvents, but they are the starting-points of further syntheses, such as that of acetic acid, which as cellulose acetate becomes the raw material for a synthetic textile which has already begun to effect a social revolution.

Hydrogenation was one of the earliest of successful catalytic processes and bid fair at one time to effect a revolution in the fat industry; it is now being extended to deal with benzenoid compounds. Active charcoal as a catalyst is still in its infancy—it is a direction in which we prophesy great developments.

A considerable section is devoted to fermentation processes, which now involve the production on an ever-increasing scale of such substances as glycerine, acetic, butyric and lactic acids; of butyl alcohol and acetone, as well as vinegar, amyl alcohol and ordinary alcohol.

We have indicated the scope of the book, partly with the object of showing to what extent the principles of catalysis are being applied in industry to produce substances of ever-growing importance, which a few years ago were scarcely of interest outside the laboratory. It is in this direction that

the potentialities of the subject are greatest, and within the next ten years we may confidently look for astounding progress. Prof. Hilditch's book may well form the 'Bradshaw' for such journeyings into the future, and we believe it will be found to be equally trustworthy. E. F. ARMSTRONG.

Early Science in the United States.

History of the Sheffield Scientific School of Yale University, 1846–1922. By Prof. Russell H. Chittenden. Vol. 1. Pp. ix + 298 + 36 plates. Vol. 2. Pp. x + 299-610 + 57 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1928.) 45*s*. net.

THESE two large and handsome volumes on the scientific department of Yale University begin with an interesting survey of the position of science in education in the first half of the nineteenth century. Dr. Chittenden gives pride of place to British scientific workers, mentioning Humphry Davy, Faraday, Dalton, Bell, Herschel, and Lyell before he passes on to the French. But when we turn to the provision of laboratories and to the place taken by science in the public education of the different countries, the story is different. France and Germany—the former on the mathematical and the latter on the chemical side—were far in advance of Britain, and it may be doubted whether the leeway has yet been made up completely. The list given on p. 18 of institutions for higher scientific and technical training in Paris in the 'thirties is amazing, and at the same time one had the famous laboratories of Liebig at Giessen and Munich attracting chemical students from all over the world. England was from that point of view far in arrear and long remained so.

It is a curious and notable fact that the United States, the youngest branch of the Western family, and endowed with the richest supply of untapped natural resources, should have clung to the most antiquated methods of higher education and been most reluctant to alter them. "There was a deep-seated aversion", Dr. Chittenden tells us, "to new ideas, especially if the latter threatened to diminish in any degree the amount of time available for the dead languages, and science, so far as it was understood, was considered of relatively small importance, and to have little educational value." He has analysed the old course of instruction at Yale, Harvard, and Williams College for the year 1845, and shows the enormous preponderance of Latin and Greek, with some mathematics, and an occasional dash of botany, chemistry, or geology.

The change, so far as Yale is concerned, w mainly due to Benjamin Silliman, who was appoint professor of chemistry at Yale in 1802. Imme ately after his appointment he was allowed perio of absence to visit other places where he could me men and study institutions likely to help him in work. In America at that time Philadelphia w the most advanced centre of scientific knowled especially of chemistry. Benjamin Franklin h founded there in 1727 both the American Phi sophical Society and also the University of Penns vania, and at the latter place Benjamin Rush, "t father of chemistry in America", was teachin There also Silliman met Priestley, who had fl from England on political grounds. But he we on to Europe and made friends in England wi Sir Humphry Davy and Sir David Brewster, b sides collecting physical and chemical apparat and the latest books on scientific subjects. Th prepared, he returned for his long period of profe sorial work at Yale. Silliman held his post wi increasing success up to 1845, and was undoubted the founder on the spiritual side of the Yale Scho of Science, to which shortly after his retirement adequate material home was provided by the mu ficence of a railway constructor named Sheffie from whom it takes the title of the 'Sheffie Scientific School of Yale University'.

The years, however, of Silliman's professorsh were passed amid the hardships of inadequate fun and cramped quarters. For fifteen years he had laboratory only a part of the cellar of the Lyceu building, a space with raised seats and a lectu table for experiments. Yet even here he manag to do work which placed him in the front rank of t American chemists of his day, and in those sa years Olmsted succeeded at Yale in making t first observation of the return of Halley's comet, 1835, and Morse, a graduate of Yale, designed electric telegraph.

In 1846, the year following Silliman's retireme from teaching, though he still remained active other spheres, the Smithsonian Institution w created by Act of Congress under the terms of t will of "James Smithson, of England, for the crease and diffusion of knowledge among men A decade later, Mr. Sheffield came on the scene wi money for buildings and endowment, and the det mination to give the institution a practical turn. railway engineer he provided amply for engineerin North, Silliman's first colleague, represented ag cultural chemistry, and the volumes before us scribe all the other branches which afterwards gr up and the leading men who have adorned them

ne second volume, with its plates representing e six or eight magnificent buildings devoted to rent branches of science and called after some thy benefactor or distinguished teacher, is uent testimony to the noble emulation of the rican citizen when his sympathies are once sed. Yale and its school of science have been fied of their sons. F. S. M.

Treatises on Astronomy.

Faculté des Sciences de Paris : Cours d'astronomie. Tome 3 : *Astrophysique.* Par Prof. Jean osler. Pp. v + 723 + 47 planches. (Paris : ermann et Cie, 1928.) 140 francs.

Trattato di astronomia siderale. Per Prof. iuseppe Armellini. Vol. 1 : *Parte generale.* p. xi + 94. (Bologna : Nicola Zanichelli, 1928.) 5 lire.

HE problems presented by the need for specialisation in science have been evident long igh to become a commonplace, but recent years e seen them grow rapidly more acute and tent. In physics, for example, the yawning grows daily more apparent, and, by a curious dox, the more desperate the efforts made to find ifying scheme for all physical phenomena, the e extravagant and impossible become the deds on a single mind attempting to cope with he problems of the subject. How a man like ate Lord Rayleigh, if spared beyond the allotted , would have kept abreast of modern develop-ts, is uncertain, though he would doubtless have d some way of doing so. What seems quite r is that, without going outside the familiar e of his own thought, he could have continued nrich the science by invaluable contributions of acteristic quality. As new fields are added, the do not become less worthy of cultivation. The ger of neglect must be avoided, even by recogng the need for distinct classes among the andmen.

, however, this be so in the case of a fundamental relatively self-contained science like physics ch yet has its debts as well as its gifts to other nces), what is to be said of astronomy, which vs fresh nourishment from every scientific er ? So late as the beginning of this century, it still possible for a young astronomer, starting with a fair stock of mathematical and physical wledge, to keep pace with the current literature is subject as it appeared. No doubt he might me professionally immersed in the technicalities ay) meridian astronomy and neglect to follow the advances in solar physics or dynamical astronomy. He may even have been wise to concentrate all his attention on one line of research. But such a course was a matter of his own taste and concern, not forced upon him. To-day the position is undeniably changed, and even the most omnivorous, after wading through all the courses of a meal no less lavish than formerly, can scarcely be expected to do equal justice to the new dish provided by atomic physics. However willing the spirit, the flesh is weak. A division of interest is inevitable, and all that is now possible is to mitigate so far as possible the evil effects of isolation. The changing circumstances will be accepted reluctantly by some who cherish breadth of outlook, but now *il faut cultiver nos jardins.*

With all this has gone a certain change in astronomical literature. Thirty years ago and less, the young astronomer had little in the way of books (with such notable exceptions as Chauvenet) to help him. He had to plunge into the sea of original papers for what he wanted, and it was good for him. The trained astronomer, brought up in this way, did not feel the want, but the absence of suitable books would have proved a distinct difficulty in establishing an academic course in astronomy similar to those provided for the study of physics.

Of course, there have long been books on astronomy which might be classed as text-books or popular works according as the didactic purpose or popular interest was predominant, but the serious student did not look to them for instruction. Among the more eminent members of the class may be recalled Laplace's " Systéme du Monde ", still famous for the germ it contains of modern theories of cosmogony. Sir John Herschel's " Outlines of Astronomy " is another example, and Newcomb's " Popular Astronomy " yet another, still kept alive by repeated revision. All these, and doubtless others, had notable qualities, but they stand out from a general poverty for which there were reasons. A work intended for the serious student commanded a market too small to be attractive. The professional astronomer, on the other hand, was generally too fully occupied to cater for the popular taste ; to have done so was apt to be frowned upon as a dereliction of duty. But times are changing, and as the subject matter of astronomy becomes enlarged, it is recognised more clearly that an endeavour to place the results of research in an intelligible form before a wide public has not merely an excuse but is a positive duty. The stream of original work grows no less, but convenient and orderly presentments of its results appear with growing and welcome frequency.

(1) Something of this line of thought is suggested by the works under review. Prof. Bosler's book on astrophysics appears as the third volume of a course on astronomy, of which the first two volumes contain a treatise on spherical and practical astronomy by Prof. Andoyer and M. Lambert. Like these, it had its origin in lectures delivered at the Sorbonne, and it forms in a sense a natural sequel dealing with the newer branch of the science, but it can be treated as a quite independent work. It is a little difficult to classify under the head of a text-book, popular handbook, or work of reference, because it has something of the qualities of all three. As a text-book based on academic lectures, it puts into the hand of the student an adequate introduction to the subject of astrophysics. But the general reader, and in particular the amateur astronomer, who is no dismayed by an occasional mathematical formula, will find the descriptive matter relieved by well-chosen illustrations finely reproduced. The references to recent literature are copious but do not pretend to be exhaustive. This will not prevent the book from being very useful to the working astronomer, at least to those whose work lies in other fields.

Prof. Bosler's book is too long for detailed discussion, but a general idea of its contents can be given. After an introductory section on instruments and methods, the work is divided into three parts, each of about two hundred pages in length. These are devoted respectively to solar physics, the physical characteristics of the members of the solar system, including comets, and to the stars and nebulæ. Thus it is to the solar system, which can be studied in fuller detail, that the greater amount of attention is given. But the space allotted to stellar problems is sufficient for the presentation of the main lines of current thought in a rapidly growing subject. The full indexes provided will greatly assist reference to the contents of a bulky volume.

(2) By a coincidence which in itself illustrates the new tendency in the form of astronomical literature suggested above, the first volume of a treatise on sidereal astronomy, by Prof. G. Armellini, appears at the same time as Prof. Bosler's work. This contains a general description of the sky, followed by a discussion of stellar photometry and spectroscopy. A second volume will be devoted mainly to the physical constitution and evolution of the stars, and a third to stellar statistics and the constitution of the universe. In method of treatment and style of production there is considerable resemblance between the work of the two authors, and in bulk the Italian treatise when complete bids fair to exceed the single French volume. Naturally, on several topi the two will overlap and afford an interesting cor parison, but the predominant place assigned by Pro Bosler to the solar system will ensure their ind pendent value on complementary lines. The appea ance of Prof. Armellini's concluding volumes will anticipated with interest, and will give a more co venient opportunity of reviewing his work when can be seen as a whole. H. C. P.

Vital Rays.

Zellteilung und Strahlung. Von Dr. T. Reiter ur Dr. D. Gábor. (Herausgegeben von der Zentra stelle für wissenschaftlich-technische Forschung arbeiten des Siemens-Konzerns.) Pp. iv + 184 3 Tafeln. (Berlin: Julius Springer, 1928.) n.

IT is now several years since Gurwitsch claime that growing roots emit some sort of influen which induces cell division in a neighbouring ro properly oriented, that is, with its axis a prolongatio of the axis of the growing root. The claim seeme improbable, and many misconceptions existe regarding the experimental work on which it wa based and the nature of the claim. But the pe vasiveness of various kinds of radiation has sinc been shown by physicists, and the possibility tha various types of radiation (in addition to those light-producing organs) can arise in the tissues organisms must now be faced. Gurwitsch an his co-workers have extended his results, an confirmatory experiments have been made b Wagner, Magrou, and others. There is thus considerable body of experimental work bearin on this subject, although Gurwitsch's theory ' mitogenetic rays ' has been adversely criticise by Guttenberg and others.

Many of Gurwitsch's experiments were don with onion bulbs and their roots, but these hypo thetical rays have also been found to emanate fro stem tips and other tissues, yeast cells, the mace ated bases of onion bulbs, the eggs of amphibian the heads of tadpoles living or macerated, an various other sources. As regards roots, they a supposed to arise not from the meristematic zon but from the base, and to pass out at the tip of th root because of internal reflection at its surfac Narcosis with chloral hydrate is supposed to inhib the production of these rays, and just as ligh production in organisms is assumed to be due t a reaction between luciferin and luciferase, Gurwitsch assumes that these rays arise whe ' mitotin ', which is killed by heat, unites wit ' mitotase ', which survives a temperature

It has since been claimed that in full-grown nals only the blood produces these rays, and e recently that the tissues of malignant tumours t them.

rom physical experiments it is concluded that rays can undergo reflection, refraction, and raction, like the ultra-violet, and that the wave- gth is about 190-230 $\mu\mu$. Using experimentally duced rays of the same wave-length for com- ison, it is claimed that onion roots are 250 times e sensitive to the 'mitogenetic rays' than a tographic plate.

n the work of Reiter and Gábor, many of these otheses and conclusions receive support. They d Gurwitsch's method of counting the number lividing cells on the side of the root exposed to 'rays' and comparing it with that on the xposed side, but they appear to have used nly cross-sections while Gurwitsch used longi- inal sections of the exposed roots. Their re- rch apparatus and methods are described in ail, so it should be possible to repeat the ex- iments. They attempt a detailed mathematical lysis of the normal growth zones and cell- ision cycles of a root meristem before taking the study of 'induction effects'. They con- r that the term 'mitogenetic rays' takes too row a view of their nature and effect, and suggest t such rays when emitted by biological objects uld be known as Gurwitsch rays.

The experimental results of Reiter and Gábor given in detail, and a few of their conclusions y be mentioned. They confirm the conclusion Gurwitsch that an 'induction effect' may be duced on onion roots by various biological ects, and that this is due to rays from various ng or pulped tissues, while non-growing (*aus- achsenen*) tissues do not show the effect. ignant tumours produce the 'rays', but benign ours do not. There is some evidence that the s affect a photographic plate, but this requires firmation.

Macerated onion bulb tissue produces the radia- only in light, while onion bulbs, tadpoles, and ignant tumours produce it also in darkness. nochromatic light of wave-length about 340 $\mu\mu$ duces the induction effect, which is not so strong n rays of 280 $\mu\mu$. Acceleration and retardation cts are obtained with amphibian eggs and larvæ subjection to monochromatic ultra-violet light, effects varying with the wave-length and the of the animal. In certain cases radiation of e-length 334 $\mu\mu$ caused the parthenogenetic elopment of amphibian eggs.

These and similar results, in which it appears to be possible to treat the radiations from certain active tissues as ultra-violet rays are used in experiment, opens the whole question of the production of radiations by living tissues or substances, a hypothesis which, if substantiated, would have far-reaching effects. Haberlandt (*Biolog. Zentbl.*, Bd. 49, Heft 4) has recently published experiments which he believes support his view that the stimulus to mitosis has a chemical basis, rather than a physical one, in the supposed Gurwitsch rays. It is possible that these views are complementary, both containing some element of truth.

R. RUGGLES GATES.

Our Bookshelf.

Tables annuelles de constantes et données numériques de chimie, de physique, de biologie et de technologie. Publiées sous le patronage de l'Union de Chimie pure et appliquée par le Comité international nommé par le VII^e^ Congrès de Chimie appliquée (Londres, 2 juin 1909). Vol. 6: *Années 1923–1924.* Première partie. Pp. xxxiv + 679. Deuxième partie. Pp. xxix + 681-1675. (Paris: Gauthier-Villars et Cie; New York: McGraw-Hill Book Co., Inc., 1927–1928.) Paper, 530 fr.; cloth, 610 fr.; 25 dollars.

THESE two books form Volume 6 of the now well-known "Annual Tables", published under the auspices of the Union of Pure and Applied Chemistry. During the War, the annual nature of the publication became a misnomer, but the arrears are gradually being overtaken, and the present volumes contain the data for 1923 and 1924. It is a sign of the increasing output of scientific research that they occupy as much space as was required for the data of the previous three years.

The object of the tables is to collect together all numerical data published during the period covered by the volume, and this ambition is, to a very high degree, fulfilled. Some forty collaborators are employed, and they search nearly 500 publications, so that very little can escape their net. This net is, in any case, spread very wide. The tables do not restrict themselves entirely to new experimental data; such numerical quantities as schemes of energy levels in atoms (which rely on previous measurements of critical potentials and of spectra) are included, as also are calculated tables for determining the inductances of coils. Short statements of the conclusions drawn by investigators from their measurements are also included, and frequently add considerably to the value of the work.

Now that the series has reached Volume 6, the search for a determination of a constant occupies considerable time, and users of the tables will be grateful for the promise made to produce an index covering Vols. 1-5.

The contents and arrangement of the present volumes are very similar to those of previous years, but an innovation is the translation into English

of all tables and explanatory matter in the sections on metallurgy and engineering. New sections are also added to deal with photography, with wireless telegraphy and related subjects, and with geophysics. The latter in particular is quite a long section and, like the one on biological measurements, will present in convenient form a mass of data which the non-specialist would find difficult to discover without some such help as is afforded by these tables.

Several of the sections have also been issued separately. J. H. A.

The Book of Remarkable Machinery. By Ellison Hawks. Pp. 296+40 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1928.) 7*s.* 6*d.* net.

THE writing of books on modern machinery suitable for boys of a mechanical turn of mind, or for others wishing to know something of the marvels effected by invention, is a difficult problem. Descriptions of new machinery contained in the technical journals often run to considerable length and are accompanied by complicated drawings, absolutely necessary, but requiring the closest attention of an experienced engineer. To attempt to compress into one book descriptions of many machines, ranging from steam engines to printing machines, from machine tools to toffee-wrapping machines, is to undertake a task which is bound to lead to criticism.

Mr. Hawks, however, has been fairly successful in initiating us into some of the mysteries of the forge and factory, and with a fine set of illustrations he has given some explanations which can be readily followed. In other cases the matter is too brief to be of much value, and such statements as that on p. 58, where we are told that the steam from a triple expansion engine exhausts into the condenser at 8 lb. per sq. in., and that on p. 131, that a steel rod 1 in. square will withstand a stretching strain of 150 tons, while a cast-iron bar of similar dimensions will withstand a strain of only 20-30 tons, are examples of the errors one unfortunately finds only too often in popular books on engineering. In such books the matter should be accurate, the explanation clear, and the treatment full enough for its purpose.

Through the Apennines and the Lands of the Abruzzi: Landscape and Peasant Life. Described and drawn by Estella Canziani. Pp. xiv+339+24 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1928.) 25*s.* net.

IN the last resort it would be difficult to decide whether the award of merit should go to Miss Canziani's paintings or her letterpress in this delightful account of a visit to the Abruzzi just before the War. Both alike are a spirited and detailed record of a primitive culture which no longer survives intact in post-War conditions. When Miss Canziani visited the country she was warned that it was not safe owing to brigandage. Though she did not encounter that peril, the attitude of the peasants at times seems alarming, to the reader at least, even if Miss Canziani takes it calmly enough.

This, however, and the discomforts, even hardships, of her journey are not matters upon which the author dwells. Her interest lies in the customs and beliefs of the people of this most primitive area of Italy. If it were not for the names of the saints and the prominent position held by the parish priest, it would be difficult to believe this a Christian country. Virtually, indeed, it is as pagan as any part of Africa over which Christianity has done no more than spread a veneer. Take, for example, the festival of Domenico, when the Serpari, descendants of Circe, who handle snakes with impunity, cast serpents in hundreds on the image of the saint as it is carried through Cocullo. This, perhaps, is extreme, but it is not atypical. The strength and at the same time the rational character of the belief in the were wolf is indicated by the statement that those who are about to become were wolves shut up their own sheep for protection before the change to the wolf form takes place. Witches of course abound, and charms against the evil eye are everywhere. Miss Canziani's work is a valuable contribution to European folklore, which will need prolonged study before its interest is exhausted.

Elements of Geophysics: as applied to Explorations for Minerals, Oil, and Gas. By Dr. Richard Ambronn. Translated by Dr. Margaret C. Cobb. Pp. xi+372. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 25*s.* net.

PROBABLY at the present time there is no one competent to write a really good text-book on applied geophysics, but the strong demand for information on the subject has stimulated the production of many books, which fall short of the ideal in very different degrees. Dr. Ambronn's work is perhaps nearer perfection than most, though still very far off. Extreme sketchiness of treatment is inevitable when the attempt is made to deal with the historical, theoretical, and instrumental sides of so wide a subject in 284 pages of text. The author has clearly endeavoured, however, to master his subject and to present it from a scientific point of view, without any axe to grind or any special methods to advocate. The extent of his reading is indicated by the fact that more than sixty pages of the book are occupied by a list of references to authors; judging from the section of this literature known to the reviewer, half of these references might have been omitted with advantage.

It will be long before this great material is properly digested and presented in the form best suited for practical purposes, and the author has not made any very marked step in this direction, though his work may facilitate the process when undertaken in the future by himself or others. The book, however, is likely to have a wide sale among commercial geologists, and justifiably, for there can be few who will fail to glean some useful information from its pages.

Letters to the Editor.

e Editor does not hold himself responsible for pinions expressed by his correspondents. Neither n he undertake to return, nor to correspond with e writers of, rejected manuscripts intended for this any other part of NATURE. *No notice is taken anonymous communications.*]

agnetostriction of Diamagnetic Substances in Strong Magnetic Fields.

HE change in shape of a body, when magnetised, be accounted for by two causes. First the sses produced by the magnetic forces act on the netic poles of the magnetised body. This effect, ch we shall call the *classical magnetostriction*, is in ven magnetic field completely determined by the netic susceptibility and the elastic constants of body. In general it will result in a contraction liamagnetic substances and an expansion for para-netic ones. The classical magnetostriction is very ll even for a strongly diamagnetic substance bismuth, where $\delta l/l$ in a field of 300 kilogauss is $1{\cdot}3 \times 10^{-6}$. It is evident that the discovery of an ct of this order would amount to a verification of classical theory of magnetisation and would afford ew information on the property of the substance. n the other hand, in a sufficiently strong magnetic we must expect another phenomenon to happen, ely, an observable change of the shape of the body ch is due to the distortion produced by the field he binding forces between the atoms. This we l call the *atomic magnetostriction*. After the modern ure (Heitler and London) of the homopolar binding es which are essentially of an electrodynamical in, such an atomic magnetostriction must occur netals and other homopolar substances. . The tion is only of the magnitude of the phenomena, ch probably must be small as it has not yet been rved in dia- or para-magnetic substances in weak netic fields.

o find whether such magnetostriction occurs in ng magnetic fields, such as are available in our ratory (*Proc. Roy. Soc.*, **115**, p. 568; 1927), a ial method has to be developed, since the field be produced only for a very short time, during ch the experiment has to be performed. We were essful in devising a method which enabled us to rve changes of length of the order of 10^{-7} occurring rod, placed in the coil parallel to the lines of netic force, the duration of the field being about ndredth of a second and its magnitude up to kilogauss. This method proved to be very rate, since, when the experiment is performed in hundredth of a second, the disturbances produced ccidental thermal variation in length of the rod negligible.

he first substance which was investigated was an ded bismuth rod, and it showed a small con-ion which was only slightly larger than that ex-ed on the classical magnetostriction. But when ismuth rod was grown in a crystal a larger effect easily observed, which could be due only to the ic magnetostriction. A more detailed investiga-showed that, when the trigonal axis was parallel he field the rod expanded; when the axis was endicular to the field the rod contracted. The raction and expansion in the same magnetic field ractically equal, so that in an extruded poly-alline rod they compensate each other, and this nts for the absence of the effect as observed with od. We were also able to trace an atomic magneto-ion in other diamagnetic substances besides bis-, but the effect was about ten times smaller and more difficult to study. We have therefore chosen bismuth as the first to be studied more carefully. The experiments are still in progress, but it seems clear that at room temperature the contraction and elongation vary according to a square law with the field, and in a field of 300 kilogauss the length changes by 5×10^{-5} (larger than is observed in ferromagnetic substances). The temperature has a strong effect, and at the temperature of liquid nitrogen the atomic magnetostriction increases several times.

These results explain why the previous attempts to find magnetostriction in bismuth failed (E. Van Aubel, *Phys. Rev.*, **16**, 60; 1903). In this experiment the largest field used was only 3 kilogauss, so that even with a crystal of bismuth the magnetostriction will be only 5×10^{-9}, but as actually polycrystalline rods were used, the effect will be only of the order of 10^{-10}, and this is too small to be measured.

The general picture of the phenomenon appears to be as follows. The cell of a bismuth lattice is very similar to a cube slightly pulled out along one of its long diagonals, which coincides in direction with the trigonal axis. In a magnetic field apparently the cube becomes still more stretched in the same direction.

From the general theory of magnetostriction (Helmholtz, *Ann. de Phys.*, **13**, 385; 1881) we must necessarily expect that such a deformation of the lattice if produced by pressure will result in an increase of the diamagnetic susceptibility perpendicular to the crystal axis and in a decrease along the axis.

The main physical interest of the phenomenon is that it may conceivably throw more light on the nature of the homopolar bonds. At present, from the general aspects of the phenomenon in bismuth, it is probable that under the influence of the magnetic field the bonds between the atoms which lie farther apart weaken, whilst those of the closer atoms are strengthened. If this view is correct, we must expect to observe larger atomic magnetostriction in the substances where the atoms are not symmetrically bound, such as tin, tellurium, graphite, and others.

P. KAPITZA.

Magnetic Laboratory,
Cavendish Laboratory,
Cambridge, June 21.

A New X-ray Effect.

IT is a remarkable but as yet imperfectly understood fact that crystalline graphite has a diamagnetic susceptibility many times greater than that of carbon in other forms, either by itself or in combination. In the hope of elucidating this phenomenon, we were led to make a careful study of the X-ray diffraction patterns of purified graphite, using a narrow pencil of the K radiation of copper, and taking special pains to avoid fogging of the plate in the vicinity of the primary beam, either by stray radiation or by photographic halation. The diffraction photographs obtained with powdered graphite in this way show a new and hitherto overlooked phenomenon (Fig. 1). We find a notable amount of scattered radiation in the area surrounding the primary beam, terminating sharply at the first diffraction ring, and reappearing with a much smaller though quite sensible intensity in the area between the first and second diffraction rings.

These observations contradict the general belief that crystals or coarsely crystalline powders do not show any appreciable X-ray scattering at small angles with the primary beam (Hewlett, *Physical Review*, **20**, 688; 1922). Our experiments show the effect to become distinctly more noticeable when graphites of

increasing degrees of fineness obtained by sedimentation were used. Blank exposures taken without the graphite, and powder patterns taken with other organic crystals (for example, hexamethylene tetramine), do not exhibit the phenomenon; it cannot therefore be ascribed to the presence of white radiation or to stray X-rays. The peculiar distribution of the scattering, and especially its relation to the position of the diffraction rings, appear to us definitely to exclude the possibility of the effect being due to any admixture of adsorbed impurities or of amorphous carbon with the graphite.

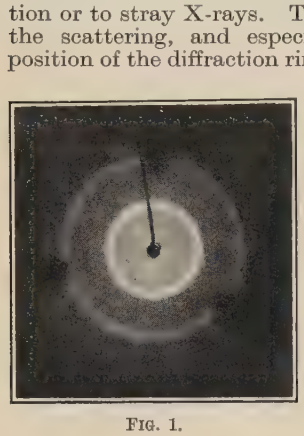


FIG. 1.

We are inclined to attribute the effects noticed by us to the fact that more or less loosely associated with the crystal lattice of graphite there are also certain mobile electrons which endow the substance with its high electrical conductivity. The success of Pauli, Sommerfeld, and others in developing the electron theory of paramagnetism and of metallic conduction on the basis of the Fermi-Dirac statistics suggests that even though graphite is strongly diamagnetic, certain electrons in it must possess large velocities, and hence cannot be regarded as an integral part of the lattice in respect of X-ray diffraction. They would therefore necessarily give rise to a scattering at small angles with the primary beam. The influence of particle size presumably depends on the magnitude of the free path of the electrons. We may interpret the increased intensity of the scattering with the finer powders as due to the distribution of the conduction electrons in the crystals becoming more and more completely chaotic with diminishing particle size. Such an interpretation is at least rendered plausible by the fact, discovered in a subsidiary investigation by Raman and Vaidyanathan, that the diamagnetic susceptibility of graphite is markedly a function of particle size, diminishing steadily to a small fraction of its full value with increasing subdivision of the substance.

C. V. RAMAN.
P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, India, June 6.

Progressive Lightning.

ON Nov. 20, 1926, NATURE published an article by me with the above title, in which I described an instrument which I had constructed in the year 1900, for investigating the progress of a lightning flash; and in the issue of Sept. 1 of last year I gave an account of the first successful photograph with it. This I obtained at the Loomis Laboratory in August last. In this later publication I indicated an improved form of instrument in which two films are carried past two fixed lenses at the same speed in opposite directions, so as to give rise to opposite aberrations of the two images of the flash. From the distortions of the images so found, the rate and mode of progress of the flash could be determined.

Since September of last year I have very greatly improved and simplified the design of the apparatus, and I am proceeding now to make the patterns for the necessary castings. I shall be getting four sets of castings and eight objectives, reflecting prisms and ball bearings, so that I may have one set for myself, one for Dr. Simpson, and one each for Mr. Loomis and Prof. R. W. Wood, in the hope that the two last named will have a better chance of securing a successful result in the frequent summer storms in America. My object in asking NATURE to publish now a description of the proposed new instrument is to attract the interest of other experimentalists, for the provision of extra castings and other gear is more advantageously made all at once than piecemeal, and the working up of the parts to the finished instrument is a small matter. I may say that I have heard from Prof. Adolf Matthias, of Charlottenburg, that he is going to make up an instrument rather larger than the one which I am making, which he hopes to take to a good district for lightning this year. For this purpose I have already given him, for his own use, a description of the latest design. I am glad to find that he is of my opinion that results obtained by this method are unassailable.

The chief objection to the instrument proposed in NATURE of September last is the use of pairs of films. These are replaced in the present design by a single film, and by the aid of right-angled reflecting prisms set so as to turn the beam of light through a right angle the two images are formed on the same film.

The accompanying diagram (Fig. 1) is sufficient to illustrate the design. *D* is an aluminium drum turned

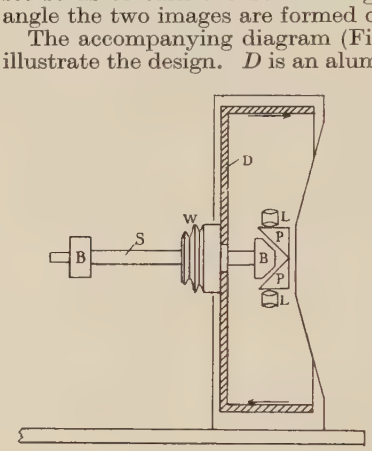


FIG. 1.

inside and out mounted on a shaft *S*, with pulley wheel *W* and carried on ball bearings *B B*. The drum may be driven by multiplying gear by hand or by motor directly coupled if preferred.

The shaft is directed towards the place where lightning ↑ is expected. The reflecting prisms *P P* and objectives *L L* form reversed images ← → on a film within the drum, and so the motion of the film gives rise to opposite aberrations. I have to thank Prof. Conradi, with whom I discussed the design last winter, for the suggestion to put the optical works within the drum instead of outside, as I was preparing to do. This has both optical and mechanical advantages. I am making the instrument to take standard Kodak films 30 in. × $2\frac{3}{4}$ in., which can be got anywhere. A drum such as this can easily be made to carry the film past the fixed images many times as fast as I carried the images over the fixed plate in my first apparatus. The film should, of course, be shielded from diffused light except at the places where the images will be formed. It would then be possible to run the drum until such a number as eight or ten flashes have been seen to be caught by the aid of a viewing prism, and no harm should result from general fog. I found with my revolving lens system that several bright flashes might supervene with none caught on the plate without serious fog, and the plate was not so shielded.

With such a camera as I have indicated above, re is good reason to expect that it would be possible detect the crawling of the lightning from point to nt in its length, for, in the much less powerful in- ument which I used in America, the two images of ash were clearly different in shape, indicating the gression of the flash.

t is evident that the optical parts could be carried an overhung shaft and be rotated within a fixed m, or by the aid of concentric shafts both optical ts and drum could be made to rotate in opposite ctions to obtain increased aberration if desired. I prefer the simpler plan described in the first ance. C. V. BOYS.

6 Victoria Street, S.W.1.

Striations in High Frequency Discharges.

N the course of an investigation dealing with the gin of the electrodeless discharge, high frequency ations have been observed in iodine vapour which apparently unlike those recently described either McCallum and Perry (NATURE, Jan. 12, p. 48) or herjee and Chatterji (NATURE, April 20, p. 605). m the accompanying photographs it will be seen

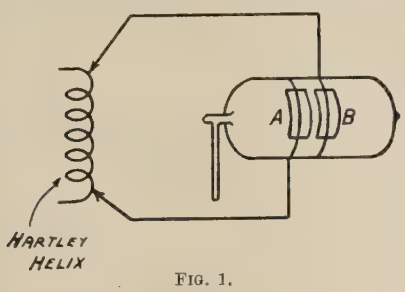


FIG. 1.

t the appearance of the striations is strongly gestive of a sine curve. They were first obtained dentally when a solenoidal coil was used with half wound back on itself, so that a high potential ted between the adjacent initial and final turns. the narrow region between these turns, of width ut one centimetre, the striation pattern was erved when the coil carried an undamped high uency current. It was afterwards found that, by ns of the arrangement shown in Fig. 1, conditions

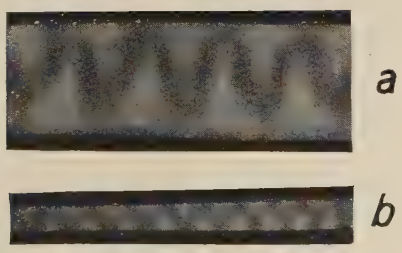


FIG. 2.

ld be controlled so as to permit of a more careful, vell as a photographic, study.

o keep the striations steady and well-defined, a able distance between the electrodes is necessary. quently, the whole pattern has a rotational motion, direction of which may be reversed sometimes ply by bringing the hand near the tube.

he length of the striations varies markedly with wave-length. Thus, photograph *b* (Fig. 2) was en with a wave-length of 65 m., and electrodes 3, 0·2 cm. apart; photograph *a* (Fig. 2), enlarged to the same extent, with a wave-length of 175 m., and electrodes 1 cm. apart. With a wave-length of 33 mm., the pattern was too fine to be photographed.

Although the striations resemble so strongly a continuous sine curve, a careful examination shows that they are in reality more like two sets of interlocking teeth. It is hoped that the exact origin of these striations will be revealed by the more extended investigation now in progress.

KEITH A. MACKINNON.
JOHN K. ROBERTSON.

Queen's University,
Kingston, Ontario,
May 14.

Dragonflies in Folk-Lore.

IN a recent letter to NATURE (June 1, p. 837) Dr. R. J. Tillyard directs attention to a chapter on dragonflies in the late Mary Webb's novel "Precious Bane". He asks if the expressions "ether's mon" or "ether's nild" used in that chapter for the dragonfly are still in use in Great Britain.

The novel is set, according to the introduction, in north Shropshire—the Ellesmere district. Hence it is worthy of note, I think, that here over the border in North Wales the Welsh name for the dragonfly, which is in common use throughout the province, is 'gwas-y-neidr'—the adder's servant. The choice of the word 'gwas' (servant) appears to be particularly suited to the legend given in "Precious Bane" which reads "where the adder lay hid in the grass there above hovered the ether's mon as a warning". An interesting parallel of the use of 'gwas' in natural history is found in 'gwas-y-gog', the cuckoo's servant, which name is given to the hedge-sparrow owing to the belief that this bird follows the cuckoo and permits the latter to lay its egg in her nest.

I am indebted to Prof. Ifor Williams (of this College) for looking up the Welsh names for the dragonfly in the older dictionaries. He informs me that Pughe, 1832 (2nd ed.), gives 'gwas-y-neidr' and 'gwaell neidr' as terms used for the dragonfly. The latter literally means 'the adder's knitting needle'. I am not aware of the use of this term in North Wales at present, but it is interesting to note that Dr. Tillyard states he believes the dragonflies are still commonly called 'devil's darning-needles' in many parts of the United States of America.

W. MALDWYN DAVIES.

Department of Agricultural Zoology,
University College of North Wales,
Bangor.

NEW ENGLAND is a long way from England, but our use of "darning needle", when I was a boy (Westborough, Mass., about 1895), is about the same as Dr. Tillyard's (NATURE, June 1, p. 837).

The 'darning needles', 'devil's darning needles', or 'blue darners' were definitely the smaller Zygoptera (Agrions). The 'blue darners' were of course in general the males, but we were not very careful in our distinctions. Larger dragonflies (Anisoptera) had no special name—they had to go as darning needles, but we felt the name did not really belong to them.

I have noticed that friends from the middle west, if they say 'darning needle' at all, mean especially the large Anisoptera; but they are more apt to say 'snake feeders', a term that is entirely unknown in our section, but recalls the "ether's mon" of Dr. Tillyard's letter. There is of course no real adder over here, and the word 'adder' is always used of a harmless snake.

I wonder if the difference of usage is related to the different source of the first immigration in the two parts of the country. New England was peopled from England and by Puritans—my own town was incorporated in 1717, long before the Presbyterian and Methodist immigrations, and still has a large proportion of the old stock. But the middle west had a substratum of Scotch, Scotch-Irish, and other Methodists and Presbyterians, dominating the New England overflow of Puritan stock. No doubt they brought different words, from a different part of Britain.

WM. T. M. FORBES.

Ithaca, N.Y., U.S.A.,
June 19.

The Electromotive Behaviour of Single Zinc Crystals.

TO NATURE of Jan. 12, 1929, p. 49, Paul A. Anderson communicated some measurements of his on the potentials of single crystals of zinc. The investigation of a possible change of the electrochemical potential with the changing density of zinc atoms on different planes of the crystal was also the aim of an experimental research commenced in October 1928 in the Physicochemical Laboratory of the University of Latvia, in Riga, and is now in progress. The results obtained here do not agree with those of Anderson in so far as no difference could be found in the potentials of different, artificially prepared planes of single crystals of zinc against a neutral zinc sulphate solution. It must be admitted, however, that pyramidal faces were not investigated.

Each experiment consisted of four measurements on four planes ((0001), $(10\bar{1}0)$, $(11\bar{2}0)$ and polycrystal), which had undergone exactly the same previous treatment. The four electrodes were submerged to the same depth in the same vessel and measured against a calomel electrode.

In all cases the potential varied with (*a*) composition of the electrolyte: saturation with hydrogen increased the potential towards the less noble potentials as compared with oxygen saturation, addition of minute traces of acid greatly decreased the potential; (*b*) previous treatment: mechanical hard treatment, etching with very dilute and dilute acids, anodic treatment. But at the same time the four different planes showed no systematic difference in potential between themselves. This seems to be due to the following reasons:

1. Mechanical treatment (rubbing with emery, polishing, filing) disintegrates the ideal crystallographic planes. The resulting structure is indefinite and shows no differences of potential.

2. Etching with dilute acids after mechanical treatment attacks the surface very unevenly and no definite plane results.

3. The plane of etching does not develop parallel to the original plane when the surface of the crystal is etched anodically or with more concentrated acids strongly enough to show the structure of the crystal. This is particularly marked for the pyramidal faces investigated by Anderson and is not true for the basis plane. The consequence will be that several crystallographic faces will be present and the potential of the least noble face will be obtained.

The same equality of potential on the three different crystallographic planes was obtained for single crystals of zinc-cadmium (up to 0·2 per cent cadmium) alloys in neutral solutions (cf. *Zeitschr. für anorg. und allgem. Chemie*, **180**, 1; 1929).

M. STRAUMANIS.

Laboratory of Physical Chemistry,
University of Latvia, Riga.

Preservation of Animal Remains.

IN a belated copy of NATURE, dated Jan. 12, which reached me a short while ago, I read with much interest a review of a recent work written by Prof. Weigelt. In that review, entitled the "Preservation of Animal Remains", Prof. Watson enumerates modes of death which are "likely to affect large numbers of individuals at the same time". To those given the following may perhaps be added.

Geological work on the eastern edge of the Ufipa Highlands, south-east of Lake Tanganyika and a few miles from the western fault line of the Rukwa Trough or Rift Valley, has brought me into conversation with others who have an intimate acquaintance with this country. A member of the Brotherhood of White Fathers, Père Pourvoyeur, recently informed me of the effect of a strong wind from the south-east on Lake Rukwa. As may be seen on any good map, the lake is topographically prolonged in a northerly direction as a very flat plain, obviously a continuation of the area now covered by water, and recently part of the lake bottom. As an eye-witness, Père Pourvoyeur described how a strong wind from the south-east forced the waters of the existing lake over the flats, carrying both fish ('Siluridés') and crocodiles with it. The cessation of this wind and the consequent retreat of the water left very large numbers of fish and reptiles to die.

From the geological point of view, a difficulty is the sufficiently rapid entombment of the bodies before total decomposition had destroyed everything, a difficulty seemingly equally applicable to the instance of Smithers Lake quoted by Prof. Watson. During some geological periods, the rate of sedimentation may have been much more rapid than any known at the present time, except in peculiar circumstances as an abnormality. At Kindope, north of Tendaguru Hill, the skeletons of a herd of reptiles were unearthed in a relatively small space by the German expedition which first worked that celebrated locality in Tanganyika Territory for Deinosaur remains. The enclosing silts are frequently false-bedded on a very small scale; the planes of lamination change direction three or four times in a few inches, suggesting the swirling action of a slowly moving quicksand. At Tendaguru also the occurrence of large isolated bones surrounded by fine-grained sands and silts implies, during the time of deposition, that the sediments had a consistency approaching that of cream. These would constitute cases where large numbers of individuals "have an exceptionally favourable chance of being preserved".

JOHN PARKINSON.

Ufipa Highlands,
Tanganyika Territory,
April 26.

Kinematographic Record of Sunrise on the Moon.

ON the night of May 17–18, 1929, between 1·5 h. and about 5·5 h. Greenwich civil time (18 d.) a moving picture was made here of the lunar crater Copernicus, showing changes in the shadows at sunrise. A Victor kinema camera, using amateur-size film (16 mm.), was employed, attached in the focal plane of the 23-inch refractor (30 feet focal length) of the Princeton University Observatory. A yellow Wratten filter No. 45 was inserted about 15 inches ahead of the film. Exposures were made every 6 seconds, approximately, for about 4 hours, on Agfa negative film. The duration of each exposure was about 3·8 seconds, controlled by the rotating camera shutter (sector opening 200°), which was driven by a belt from a light electric motor carried in the same aluminium frame.

More than 50 feet of film was obtained, with above 00 successive pictures of a region around Copernicus, out 200 by 330 miles in size, the ring-plain being in middle. Guiding was with a power of 700 and a cial eyepiece, which received light from a cube sm just ahead of the film, the diagonal surface of ich was lightly silvered to divert about half of the ht.

The exposure was too short to show the faint mination on the low-lying areas outside Copernicus the exact terminator; but the retreat of the shadow the 'eastern' ridge down the inner slope of the estern' ridge is well depicted. The age of the moon s 9·0 d. on May 18 at 6 h. G.C.T. The guiding was ly fair, but the positive made from the film makes good show when projected. (It will be remembered at Jupiter has already been depicted in motion tures by W. H. Wright.)

Further development of the apparatus is planned. e low illumination at the terminator offers the chief ficulty, because if the exposure is made long, the ole film is rather short when projected. Technically isfactory pictures may be helpful to serious investi- tors of the detailed topography; but the vivid neral interest possessed by moving pictures of the on justifies the effort of securing them.

R. F. ARNOTT.
E. G. F. ARNOTT.
Princeton, N.J., A. L. BENNETT.
June 10. J. Q. STEWART.

Heisenberg's Indetermination Principle and the Quantum.

THE Heisenberg principle states that $\delta p \delta q \sim h$, where and q are two canonical conjugates. Energy and ne are such conjugates. For the quantum, $E = h\nu$ d we have

$$\delta(h\nu)\delta t \sim h \text{ or } \delta\nu\delta t \sim 1 \quad . \quad . \quad (1)$$

ere t is the time the quantum has been travelling m its source. If x is the distance the quantum has velled in time t, then $\delta t = \delta x/c$, where c is the locity of light, so that

$$\delta\nu\delta x \sim c \text{ or } \delta\lambda\delta x \sim \lambda^2 \quad . \quad . \quad (2)$$

ce $\delta\nu = c\delta\lambda/\lambda^2$, neglecting sign.

From the classical theory (Compton, "X-Rays and ectrons", p. 55) the amplitude of a radiating illator decreases according to $A = A_0\epsilon^{-kt}$ due to mping, where $k = (4\pi^2/3) \cdot (e^2/mc\lambda^2)$ and e is the arge on the electron. The effective length of a ve-train may be taken as the length for A to be duced to A_0/ϵ and is c/k. This length may be taken the uncertainty δx of the position of the quantum, that

$$\delta\lambda \sim k\lambda^2/c \text{ or } \delta\lambda \sim (4\pi^2/3) \cdot (e^2/mc^2). \quad . \quad (3)$$

I have previously calculated the width of a spectrum e due to damping by the method of the Fourier egral (*Phys. Rev.*, **19**, 64; 1922) and have obtained width $\Delta\lambda$ between half values of the maximum ensity of

$$\Delta\lambda = (4\pi/3) \cdot (e^2/mc^2) \quad . \quad . \quad (4)$$

It is interesting to note that $\delta\lambda$ and $\Delta\lambda$ are of the me order, namely, 10^{-12} cm. Does the Heisenberg inciple therefore imply that a spectrum line given t by, say, a mercury atom, has a width in addition the width due to the Doppler and pressure effects? n a single quantum itself have a frequency width? hen mercury resonance radiation is absorbed in rcury vapour, it seems necessary to assume a dth for a single quantum if any absorption at all to occur.

G. E. M. JAUNCEY.

Washington University,
St. Louis, Mo., U.S.A., May 24.

Vibrational Quantum Analysis of Red Cyanogen Bands.

A STUDY of the red cyanogen bands shows that the band at $\nu 14430$ is not the true $0\text{-}0$ band of the system. Six new bands on the higher λ side have been photographed on neocyanine plates, from the spectrum of cyanogen as developed in active nitrogen (R.K.A.) and of the high current density arc (J.W.R.). These can be fitted in a simple manner in the existing n'/n'' table for the red cyanogen bands, by extending the n' progressions as under:

n'/n''.	0.	1.	2.	3.	4.
0	10937 (*a*)				
1	12697 (*a*)	10654 (*b*)			
2	14432	12393 (*a*)			
3	16143	14099	12086 (*a*)		
4		15788	13769	11782 (*a*)	
5			15430	13439	11480 (*a*)

Numbers denote ν of the most refrangible head.
(*a*) denotes *new* bands found in active nitrogen and in arc.
(*b*) found in arc only.

This arrangement does not invalidate the existing analysis completely, and appears to be satisfactory. It is not certain that the band at $\nu 10937$ is the $0-0$ band, which may be higher up in the infra-red, beyond the range of sensitivity of the photographic plates now available. ω_0'' and $\omega_0''x''$ retain their old values; ω_0' is uncertain, but $\omega_0'x'$ retains the old value. The vibrational equation deduced from the present experiments, assuming $\nu 10937$ to be the $0-0$ band, is:

$$\nu_{(\text{head})} = 10937 + (1782\,n' - 13{\cdot}5\,n'^2) - (2055\,n'' - 13{\cdot}3n''^2).$$

R. K. ASUNDI.

Wheatstone Laboratory,
King's College,
London, W.C.2.

J. W. RYDE.

Research Laboratories of the
General Electric Co., Ltd.,
Wembley.

The Raman Effect in Carbon Disulphide.

IN view of the interesting observations of Rasetti with carbon dioxide (NATURE, Feb. 9 1929), the Raman spectrum of which was found to contain no lines corresponding to any of the observed infra-red absorption bands, the results obtained in the analogous compound carbon disulphide may be noteworthy. The scattered spectrum of this liquid gives two prominent frequency shifts, 655 and 800, corresponding to $15{\cdot}27\,\mu$ and $12{\cdot}50\,\mu$ respectively. The infra-red absorption of the liquid was studied by Coblentz in the region $2\,\mu$ to $15\,\mu$, and he gives the following values for the absorption bands—$3{\cdot}2\,\mu$, $4{\cdot}6\,\mu$, $6{\cdot}8\,\mu$, $11{\cdot}65\,\mu$, and $13{\cdot}4\,\mu$. All these bands, except the first, are very strong, the one at $6{\cdot}8\,\mu$ being the most prominent. It is significant that none of these bands are represented in the scattered spectrum.

The Raman line corresponding to the frequency shift 655, excited by 4358, is very strong in the spectrum and has an anti-Stokes' line the intensity of which is less than 1/50 of it. The value calculated for the intensity ratio between the negative and the positive lines according to the relation $e^{-h\nu/kT}$ comes out to be 1/20. Whether this discrepancy in the relative intensity has any connexion with the absence of the corresponding infra-red absorption remains to be determined.

A. S. GAVESAN.
S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, May 23.

The Ozone in the Earth's Atmosphere.

By Dr. D. N. HARRISON.

THE first accurate measurements of the amount of ozone in the atmosphere were made by Fabry and Buisson at Marseilles in 1920, and their method has been modified and developed by Dr. G. M. B. Dobson and others,[1] so that ozone observations are now made regularly at least once a day at about half a dozen places in different parts of the world. The results obtained up to the present from these series of observations are the subject of this article.

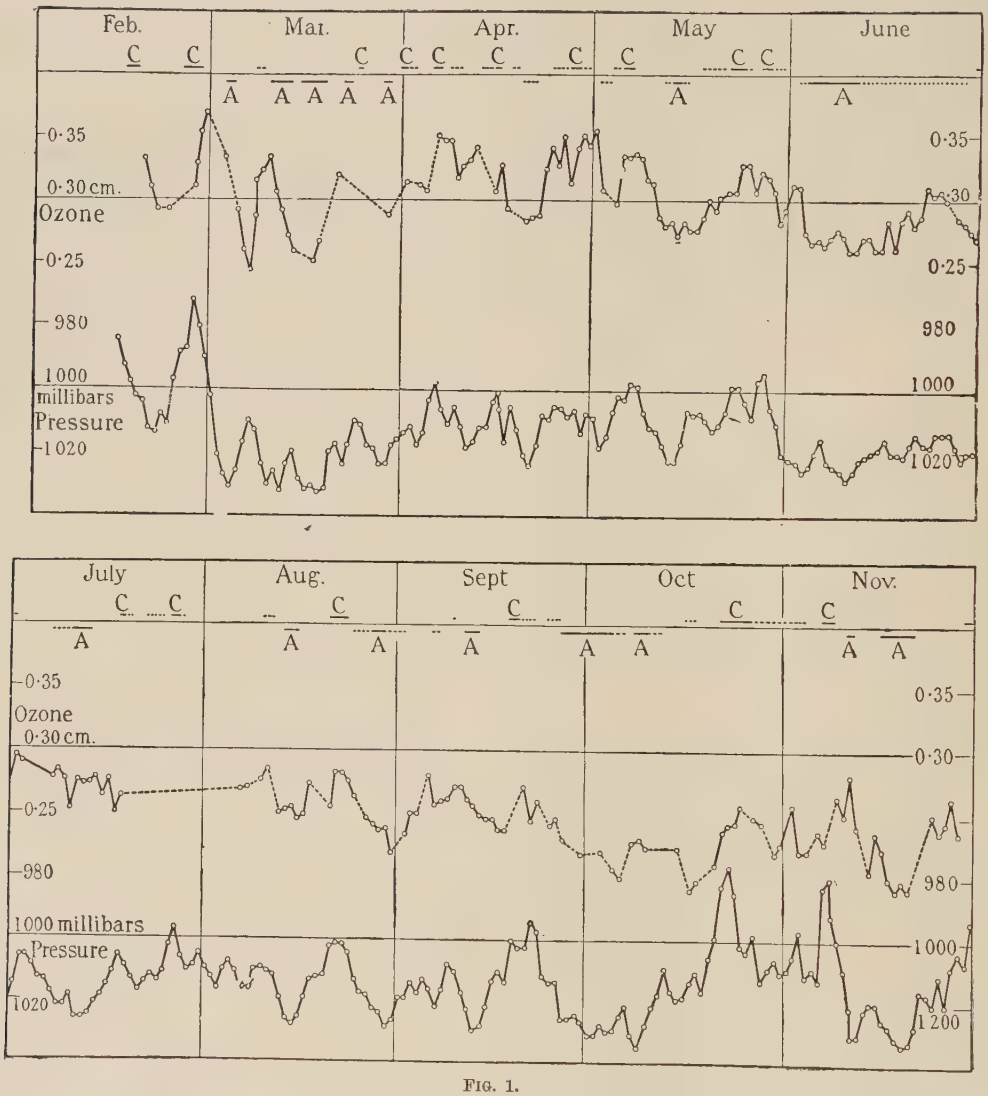


FIG. 1.

Ozone has an absorption spectrum consisting of bands in the infra-red, a weak band in the visible, and a very strong band in the ultra-violet, which cuts off the solar spectrum completely at about 2900 A. Its equilibrium temperature in sunlight is therefore higher than that of the other constituents of the atmosphere, which have no ultra-violet absorption. Moreover, atmospheric ozone was known to be confined to a region many kilometres above the earth's surface. Thus variations in the amount of ozone would be expected to affect the temperature of the upper atmosphere, and it was thought that in this way it might play an important part in the various changes which the atmosphere undergoes.

Ozone, as is well known, is a form of oxygen having three atoms in the molecule. It is formed from oxygen by the action of ultra-violet light of shorter wave-length than that which ozone itself absorbs. The spontaneous decomposition in the absence of a catalyst is extremely slow, but by absorbing ultra-violet radiation ozone is transformed into oxygen, so that in the absence of other factors the amounts of oxygen and ozone would

[1] *Proc. Roy. Soc.*, A, vol. 110 (1926), p. 660; vol. 114 (1927), p. 521; vol. 122 (1929), p. 456.

tend toward equilibrium, depending on the distribution of intensity in the solar spectrum. It was thought at one time that solar radiation was one of the main sources of atmospheric ozone, but this is probably not the case, for reasons which will be explained later.

METHOD OF MEASUREMENT.

Briefly, and without technical details, the method by which ozone is measured is as follows. The method is spectroscopic; since ozone absorbs ultra-violet light of certain wave-lengths, the intensity of this light reaching the earth from the sun depends on the amount of ozone in the atmosphere; the intensity of the light is measured photographically, and consequently the amount of ozone through which it has travelled can be found. This is expressed as the thickness of a layer of the pure gas at N.T.P.; it varies about a mean value of roughly 3 mm. in Europe. In actual fact, of course, the ozone is spread through an unknown depth of the atmosphere, and this method of expression merely gives the number of molecules per horizontal square centimetre. The accuracy of the measurements is such that the results can usefully be expressed to three significant figures; the unit is usually taken as 0·001 cm., so that 321 would mean that the amount of ozone was equal to that in a layer 0·321 cm. thick at N.T.P.

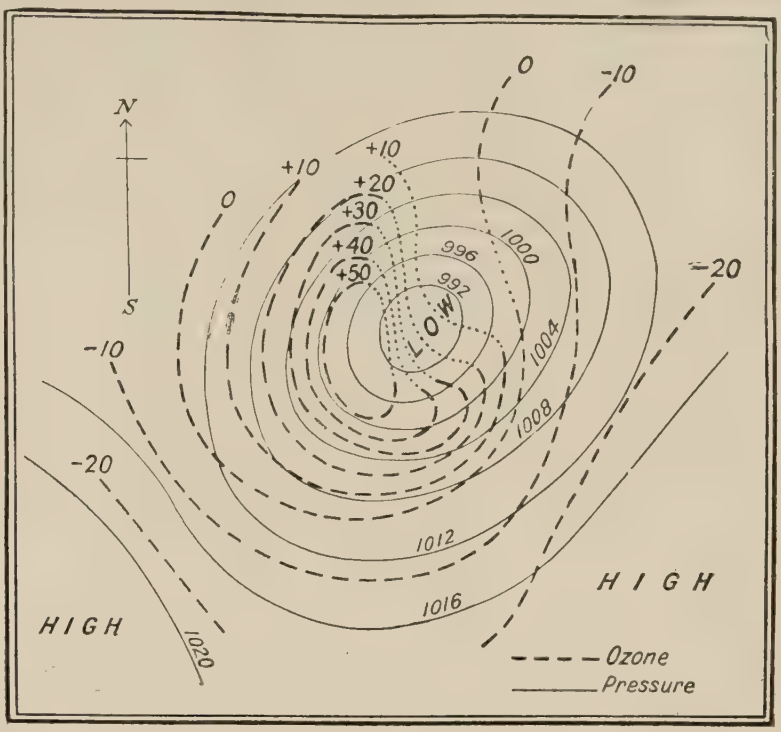


FIG. 2.

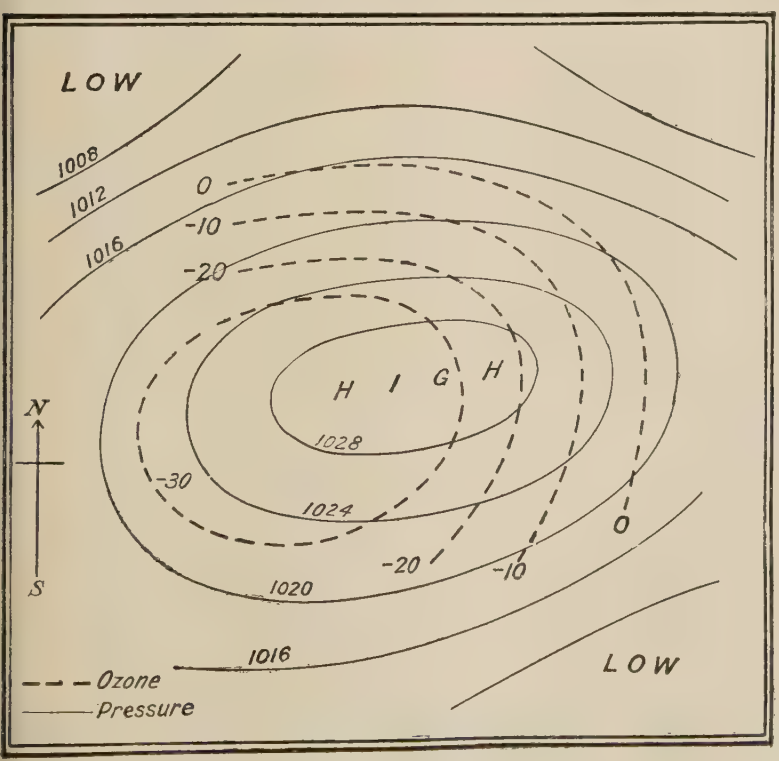


FIG. 3.

The height of the ozone layer can also be deduced. Several different workers agree in placing it at about 40-50 km.; this probably represents the 'centre of gravity' of the layer. The height appears to be greater when the amount of ozone is large than when it is small.

DIURNAL AND ANNUAL VARIATIONS.

It was discovered at Oxford in 1925: (1) that the amount of ozone can vary greatly from day to day, and indeed during one day; (2) that these variations have an inverse connexion with the barometric pressure; and (3) that there is a marked annual variation with a maximum of about 330 in April and a minimum of about 220 in October, taking a smooth curve through the year. Fig. 1[2] shows the ozone values for 1925, together with mean

[2] The illustrations are reproduced by kind permission from the *Proceedings of the Royal Society*.

pressure for each day at Oxford. The short horizontal lines A and C above the curves mark the occurrence of cyclones and anticyclones.

are accompanied by definite and characteristic changes in the quantity of ozone in the atmosphere above any given place. Measurements

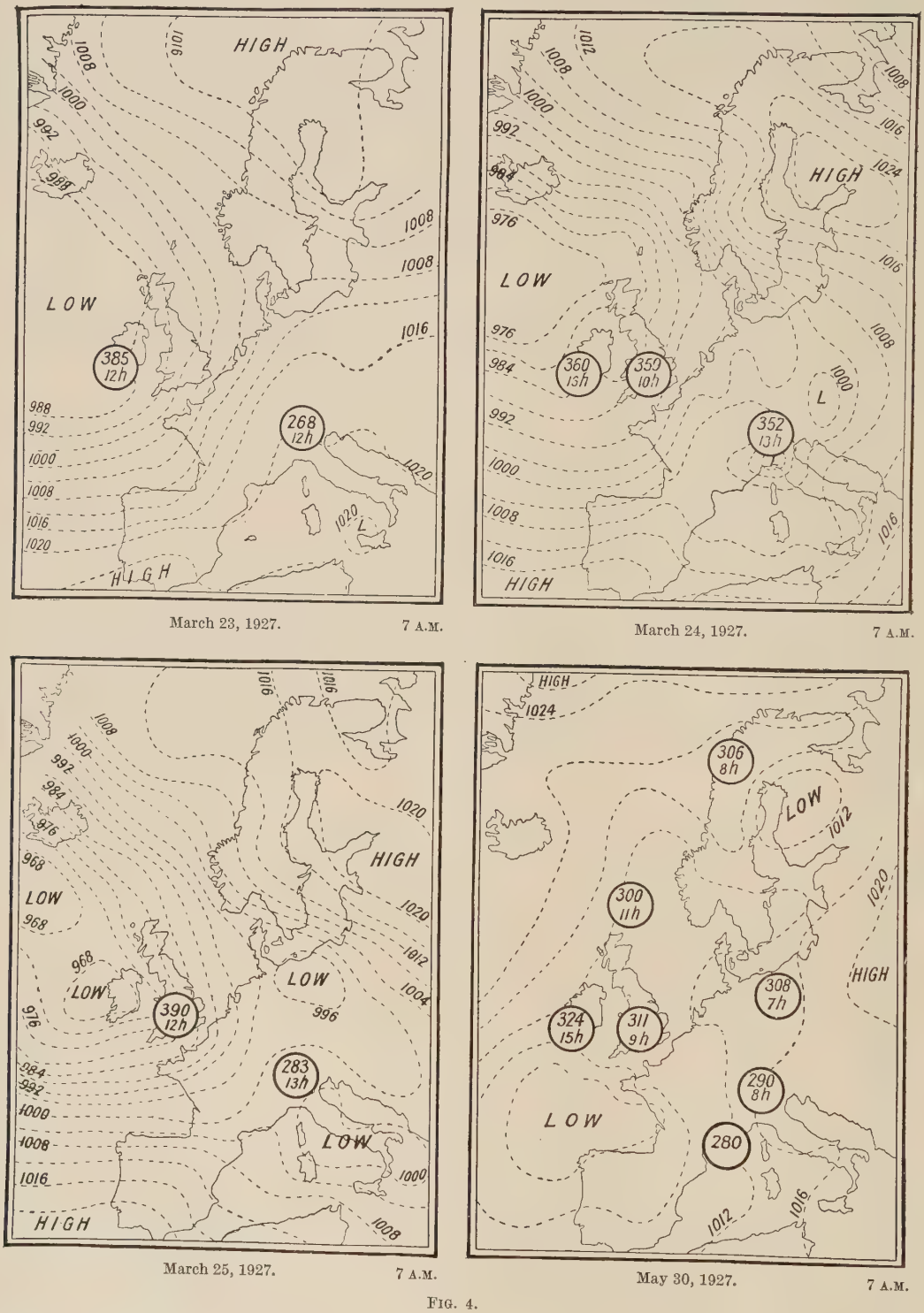


FIG. 4.

Subsequent observations at other places confirmed and amplified these conclusions, and it is now certain that the various sequences of weather were made at Oxford, Lerwick (Shetland), Valentia (south-west Ireland), Abisko (Norway), Lindenberg (near Berlin), Arosa (in the Alps), and Marseilles

during 1926 and 1927, with the view of discovering the distribution of ozone at different times, in the same sort of way as that in which weather maps are plotted by the aid of a network of reporting stations.

OZONE AND WEATHER.

The general conclusion so far reached is that there is a very close connexion between the ozone and the origin of the great air-currents the interplay of which gives us our 'weather'; the connexion is closest when the air considered is that not at the surface, but in the stratosphere (the isothermal region) which begins at a height of roughly 10 km. These currents are named by meteorologists 'polar' and 'tropical'; polar air is associated with high ozone values and tropical air with low ozone values. When studied in connexion with a weather map, the changes of ozone with the fluctuations of these air masses are most striking. There are difficulties, however, in the way of assuming that the varying quantities of ozone are actually brought by the air-currents.

Fig. 2 shows the average distribution of ozone in a cyclone. It was obtained by drawing the isobars for a typical or idealised cyclone, and plotting for each individual case the ozone value in its appropriate position; in order to eliminate the annual variation, the ozone values are expressed as differences from the mean for the time of year, so that the figure shows in units of 0·001 cm. the changes which, on the average, take place during the passage of a cyclone. (The figure should be imagined to move from left to right, that is, from west to east.) It will be seen that the ozone begins to fall at some distance in front of the depression, when tropical air is arriving at high altitudes, remains low during the passage of the 'warm sector' (roughly the south-east quadrant of the cyclone), and rises rapidly just behind the centre; this sequence of changes in a cyclone is found practically without exception, and even a small secondary (judged from the weather-map) may be followed by a large and abrupt rise of ozone. The highest ozone values found are those at the rear of depressions.

Fig. 3 shows the average distribution of ozone in an anticyclone; here we see that ozone tends to be low and that the minimum comes after the maximum of pressure.

The highest value hitherto found is 420 and the lowest 172.

Typical 7 A.M. weather maps, with ozone-values and hours of observation, are reproduced in Fig. 4. In the first three maps the passage of a secondary depression over Arosa is accompanied by a large but temporary rise of ozone; in the fourth map comparatively uniform conditions are illustrated.

The correlation co-efficients between the amount of ozone and upper air conditions are among the highest found in meteorology. The correlation with surface pressure is high, but those with the pressure at heights of 9-14 km. are much higher, and very high values are found for temperature in the troposphere and for the height of the base of the stratosphere; these are all negative, as would be expected from what has been said, while that for the temperature at 14 km. (in the stratosphere) is positive.

So far we have considered the distribution in Europe, about the latitude of Great Britain. We now turn to the world-wide distribution, so far as it is known. Observations at Montezuma (Chile) and at other places within the tropics give remarkably uniform and constant values of about 200 to 220, which is about the value found for tropical air in Europe in the summer. At Montezuma there seems to be a small annual variation, with a maximum in the southern spring.

Observations in high latitudes are scanty, but it seems probable from the Abisko figures that there is a maximum of perhaps 400 in the spring, after which the amount of ozone falls rapidly through the summer and autumn. In this connexion Prof. Rosseland's letter in NATURE, Feb. 9, is of interest. As was predicted by Dr. Dobson, photographs of the spectra of stars taken within the Arctic circle in December were cut off at 3000 A. by ozone.

A few observations from New Zealand indicate that there the amount and variations of ozone are similar to those in Europe.

ORIGIN OF OZONE IN THE ATMOSPHERE.

These results are of great interest from their bearing on the probable origin of atmospheric ozone. The ozone is at a minimum in the tropics; it is at a maximum in Arctic regions after the winter night, and decreases rapidly as the sunlight becomes stronger. Therefore we must conclude that the amount of ozone in equilibrium in sunlight is relatively small (perhaps about 2 mm.) and there must be some other source of supply. The rate of decomposition in sunlight must be slow, since observations near sunrise and sunset indicate no regular decrease during the day.

The origin may possibly be found in the aurora, or some associated phenomenon of which we know nothing. The amount of ozone is related to magnetic conditions in the sense that high ozone values tend to occur at times of magnetic disturbance, and a marked auroral display is always accompanied by a magnetic storm. Nevertheless, the aurora is situated at a height of 100-500 km., far above that found for the ozone layer. Further evidence of the presence of ozone at about 50 km. is given by temperatures found near this level. Dobson's and Lindemann's observations of meteors gave a high temperature above 55 km., and observations of sound-waves indicate a temperature at about 40 km. as high as that at the earth's surface.

Although no simple relation between ozone and weather has been found, the results here outlined show that the problem is full of interest; and in any case no one would expect, with such a complicated machine as the earth, its atmosphere, and the sun together form, to disentangle one complete thread of cause and effect.

Polyploids and Polyploidy.

By C. D. DARLINGTON.

WHEN a cell divides to produce two daughter cells having the same genetical properties as itself, the nucleus resolves itself into a definite number of structures, the chromosomes. These, splitting lengthwise, give rise to two identical groups which go to make the daughter nuclei. In this process, known as mitosis, it is evident that, with certain exceptions which need not be gone into here, the chromosomes into which the nucleus resolves itself are always identical in number and form with those which went to constitute it at the preceding division. The chromosome number is said to be constant. It follows that when, in the course of sexual reproduction, two germ-cells unite to form a zygote and their nuclei fuse, the new generation of cells thus established will show at mitosis a new chromosome outfit or 'complement', the sum of those of the two germ-cells. When these are identical the number will be simply doubled, and in these circumstances the number of chromosomes in the germ-cell is said to be 'haploid' and the double number of the zygote is said to be 'diploid' (see Fig. 1). Further, when the

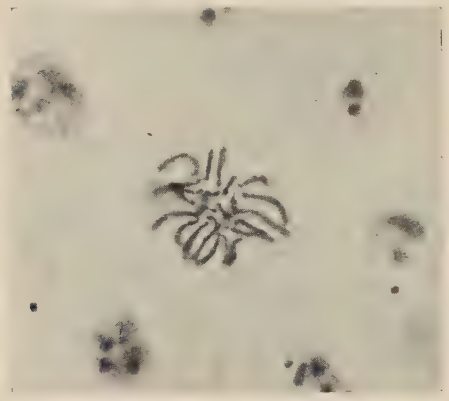


FIG. 1.—The diploid chromosome number (24) in a root tip of *Tulipa Clusiana*, a form from Tibet.

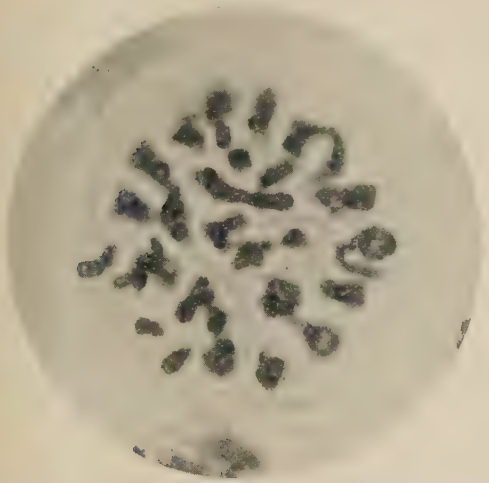
new zygote comes to produce germ cells, which by their union will reconstitute a diploid individual like itself, the zygote nuclei undergo a process of 'reduction', by which a new cell generation is produced having the haploid number of the gametes.

These three processes provide the mechanism that determines the Mendelian laws of inheritance, and so long as mitosis, fertilisation, and reduction follow a regular course, the Mendelian laws, with all the complications that are implicit in them, are obeyed. But all three processes are liable to error. In the first place, we frequently find body cells, both in plants and animals, the chromosome numbers of which are double those characteristic of the individual and its species. This type of 'doubling' probably follows the failure of two bodies of chromosomes to separate after mitosis, or the simultaneous division of two nuclei which have not been separated by a cell-wall after the preceding cell-division. In plants, owing to their unlimited growth, such 'doubled' cells sometimes produce germinal tissue, and a new tetraploid race, such as *Primula kewensis*, with four times the haploid chromosome number, is established. Doubling is so frequent in the formation of a callus in the tomato that we can be certain of obtaining a proportion of tetraploids amongst the adventitious shoots thrown up from the callused wound when the stem is cut off. In the normal course of development, doubling has been found to occur frequently in the embryo-sac nuclei of several plants belonging to the Liliaceæ. Usually the doubling occurs at the opposite end of the embryo sac from the egg-cell, but sometimes the egg-cell itself is affected, and in these cases fertilisation of the diploid female gamete will produce a new triploid individual.

In the second place, abnormalities in fertilisation occur which give rise to a different kind of change. Various stimuli may excite the development of the egg-cell without fertilisation. For example, when an interspecific cross, such as hexaploid *Solanum nigrum* by tetraploid *S. luteum*, is attempted, the stimulus of pollination sometimes excites the development of the egg-cell with the reduced (triploid) number, although the pollen-nucleus does not fuse with the egg-nucleus. Similarly, by the stimulus of changes of temperature, an egg-cell in *Datura* can be induced to develop. In these ways a haploid, or relatively haploid, individual arises having the hereditary material of a germ-cell and the outward form, on a reduced scale, of a diploid plant. Experimentally it has been found possible to induce the fusion of two male germ-cells with one female; in the formation of the endosperm we have virtually the reverse case of the fusion of two female germ-cells with one male. From both these unions a triploid cell generation is produced.

It is in the finely regulated processes of reduction, however, that irregularities most frequently occur, and these irregularities are of great importance in the production of polyploids. In considering reduction, two properties of the chromosomes should be particularly borne in mind. First, the material of which the chromosomes are made up has specific physiological properties, so that, to take a simple example, if one type of chromosome is represented in the organism three times instead of twice, constant physiological changes are produced. To take another example, if one of the chromosomes of a haploid gamete is lacking, the gamete is not usually viable. Secondly, where, as is usually the case, the diploid organism is the result of the union of two similar gametes, the chromosomes contributed by these gametes must correspond in pairs. They must be structurally and functionally homologous. When, therefore, we see pairs of chromosomes formed at reduction, it is a legitimate assumption that these are pairs of homologous

hromosomes and that they pair because they are ke. Further, where pairing fails, it is perhaps atural to conclude that this failure is the result f lack of likeness or affinity. Exceptions to this ıle we shall return to later. In the main it is true,



IG. 2.—Pollen mother-cell division in a pentaploid form of *Tulipa Clusiana* (60 chromosomes) showing associations of various numbers of chromosomes, and some chromosomes unpaired.

nd it is as a consequence largely of failure of airing that irregularities in reduction arise in ybrids.

The simplest form that these irregularities can ake is the failure of the two corresponding groups f chromosomes to separate, and the consequent rmation of a single nucleus with the diploid umber. This nucleus then divides to give two uclei in which the number is similarly unreduced. erm-cells have been shown to arise in this way in rge numbers of plants, which are either of known ybrid origin (like *Raphanus-Brassica*) or believed n independent grounds to be hybrids (like species f *Hieracium*). In *Pygæra* hybrids, where the rmation of diploid germ-cells, with complete ilure of chromosome-pairing, was first observed, ıe nuclear phenomenon was shown to be corre-ted with the fact that the character differences mpletely fail to segregate. This is one of the scoveries on which the chromosome theory is ased.

If the conditions of the origin of polyploids *before e fact* are almost universal, the conditions *after e fact* impose important limitations on their aintenance. These limitations are almost all ound up with the processes of sexual reproduction. here the sexes are differentiated, doubling of the romosome number may be associated with erility on one side, as in *Pygæra* hybrids, and nsequent failure of the tetraploid to perpetuate elf; or there may be a change in the method of production, as in *Artemia* where a tetraploid is rthenogenetic, or *Empetrum* where a tetraploid hermaphrodite, the diploid that probably rresponds being in each case unisexual.

In a different way the purely mechanical con-tions of reduction greatly limit the success of those polyploids which reproduce sexually. The conditions under which the corresponding chromosomes separate regularly when present in pairs are not always equally satisfactory when more than two of each kind are present. For example, in a triploid, where there are three of a sort, the odd chromosomes, whether associated with the pairs or not, separate at random to the two daughter cells. Consequently the germ-cells produced have chromosome numbers varying between the haploid and the diploid number (see Fig. 3). In these new intermediate types the balance of the physiologically differentiated chromosomes is new, untried, and in most cases unsuccessful. Most triploids are therefore sterile so far as sexual reproduction is concerned. Triploidy is none the less common both in natural species and in cultivated plants, but a study of its incidence shows that in these established triploid forms sexual reproduction has lost its value. Triploids occur, for example, in plants with various kinds of natural vegetative propagation in *Hyacinthus*, *Tulipa*, *Iris*, *Rubus* (Fig. 4), *Canna*, and *Tradescantia*; with reproduction by grafting in *Prunus*; with apogamy in *Hieracium*; with partial parthenocarpy in the cultivated apples; and probably with both apogamy and parthenocarpy in cultivated *Citrus*. To such forms as these it is clear that ordinary seed fertility, so far from being an advantage, may actually become a hindrance.

The case of tetraploids is more complicated, both in regard to chromosome behaviour and to the fertility that largely depends on it. For the sake of simplicity, let us take two opposite types. From a haploid *Datura*, itself the result of the development of an unfertilised egg, diploid offspring have

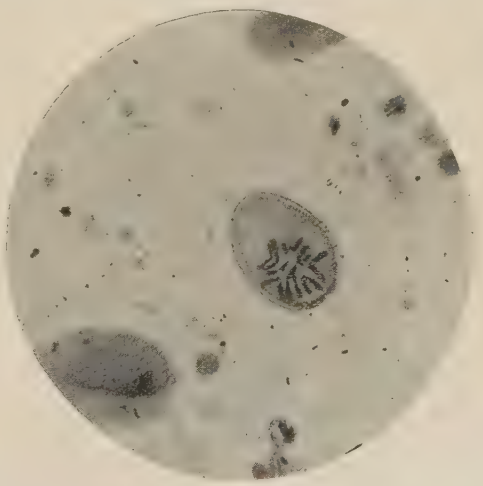


FIG. 3.—A pollen grain of a triploid hyacinth (somatic number, 24) showing 13 chromosomes; numbers between 8 and 16 have been found. Note the three chromosome types.

arisen by failure of reduction, and from these again tetraploids. In such tetraploids there are four identical representatives of each chromosome type, which usually associate to form quadrivalent bodies at reduction. These quadrivalents are, of course, capable of dividing into two and two, but seem to

be subject to irregularity in division, for gametes arise (as in tetraploid *Prunus cerasus* and *Tradescantia virginiana*) both with more and less than the normal gametic number, and the fertility of such tetraploids is consequently reduced.

We may mention parenthetically that, just as the functional gametes must contain two out of the four chromosomes of each type chosen at random, so the breeding results in tetraploid *Datura* and *Primula sinensis* have always agreed with the assumption that two Mendelian factors, chosen at random from four, pass to each gamete. This agreement, verifying prediction, is a substantial corroboration of the chromosome theory of heredity.

On the other hand, we have tetraploids arising as a result of doubling in hybrids. The result depends on what we may loosely call the 'degree of hybridity.' *Primula kewensis* is not an extreme example, and will serve to show the peculiarities

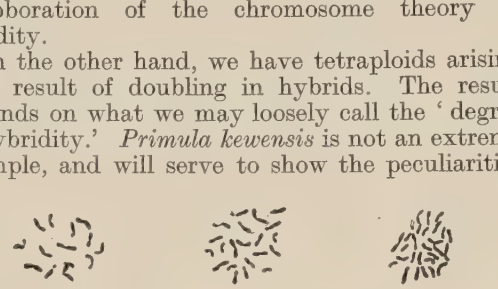


FIG. 4.—Diploid and polyploid species and varieties of *Rubus*. All the even multiples are fertile, although the tetraploid and hexaploid are known to be interspecific hybrids. The odd multiples are both sterile in a high degree.

associated with various degrees of hybridity. It is the result of a cross between *Primula floribunda* and by *P. verticillata*, which gave in the first instance a sterile intermediate diploid hybrid, as might have been expected. This diploid produced a giant fertile shoot the offspring of which were fairly constant, giant, and fertile like itself. This shoot was tetraploid and must have arisen as a result of the formation of tetraploid somatic cells, as in *Solanum*. In the diploid hybrid, the corresponding chromosomes of the two parental species paired at reduction; its sterility must therefore be assumed to be the result of failure of the new genetic combinations brought together in the gametes. In the tetraploid, however, pairs are usually formed as in the diploid, but the general absence of segregation means that identical mates must pair and pass to opposite gametes.

This conclusion is justified by the fact that a small proportion of segregates is produced bearing certain characters of the parental species, that is, no longer intermediate in every respect. In a similar small proportion of cases the chromosomes associate in fours, derived therefore from both species and capable of yielding gametes pure in the characters of one species carried by the chromosomes concerned. It follows that the constancy and relative fertility of the hybrid tetraploid depends on its degree of hybridity, for, in so far as the corresponding chromosomes of the opposite species are capable of pairing in the tetraploid derivative, dissimilar gametes will be produced, both as a result of genetic segregation and abnormality in the division of quadrivalents. In both cases fertility is reduced.

These remarks, which are based on theoretical considerations, are in agreement with all the available experimental evidence. Fertile diploids such as *Œnothera Lamarckiana*, *Datura Stramonium*, *Primula sinensis*, *Solanum Lycopersicum*, and *Campanula persicifolia* give less fertile tetraploids. Sterile diploids such as *Primula kewensis*, *Raphanus-Brassica*, and relatively diploid *Nicotiana* and *Solanum* hybrids give more fertile tetraploids.

It is therefore possible for a tetraploid arising from a hybrid diploid to have the mechanical properties of a fertile diploid. But it combines with these certain genetical peculiarities. Not only is it a hybrid, with such physiological advantages as hybridity may confer, but occasionally the corresponding chromosomes of the opposite diploid parents may pair. The tetraploid will then show the segregation of a hybrid, and may give rise to offspring with any workable combination of the characters of its two parents.

(*To be continued.*)

Obituary.

PROF. R. J. HARVEY-GIBSON.

THE death in Glasgow on June 3, at sixty-nine years of age, of Dr. Robert J. Harvey-Gibson, emeritus professor of botany in the University of Liverpool, will be widely regretted. Prof. Harvey-Gibson was a son of the manse and was educated in the Universities of Aberdeen, Edinburgh, and Strasbourg. He first held appointments as demonstrator in zoology and later in physiology in the University of Edinburgh. His association with the University of Liverpool goes back to the year 1883, in which his first appointment was that of demonstrator in biology in the old School of Medicine, which was later amalgamated with University College as the foundation of the present University. At the amalgamation, Harvey-Gibson was promoted to a lectureship in botany, which became in 1887 a subject in the new Faculty of Science. The institution and growth of a Department of Botany under his direction soon followed, and in 1889 a new laboratory was erected to meet the needs of the Department. The first assistant in the Department was Dr. A. J. Ewart, and when in 189[illegible] Mr. Holbrook Gaskell made possible the foundation of a chair of botany, Harvey-Gibson became its first holder and worked arduously for the advancement of the Department and the acquisition of modern laboratories. At that time Dr. J. C. Willis was a student in the Department. In 1900 Mr. Hartley offered to build a new laboratory, and in 1902 the present Department was erected to the plans o

rof. Harvey-Gibson, and was officially opened by ir W. Thiselton-Dyer.

It may truly be said that Harvey-Gibson de-oted himself to the construction and equipment of department, and that in this he built largely for is successors. Yet he found time for investiga-ion and writing on varied subjects, for he was of atholic interests, and for administration in many elds of University activity. His chief contribu-ons to his subject are a series of papers on marine lgæ, the Lycopods, and on questions of systematic natomy, and he was the author of philosophical ssays, an outline of the history of botany, and other orks of a more general nature. He was keenly nterested in the military training of undergraduates nd was the founder of the Officers' Training Corps f his University. During the War he served as a olonel in the Territorial Army and took an active art in the work of the Red Cross Society.

Harvey-Gibson was a man of scholarly achieve-ent, and although he had been in indifferent ealth for some years, he maintained a lively in-erest in all branches of his subject and in classical tudy.

Mrs. Theodore Bent.

THE death of Mrs. Theodore Bent on July 3, at he age of eighty-three years, has removed a strik-ng personality for many years familiar in literary nd scientific circles in London. She was the widow f Theodore Bent, whom she married in 1877. Of rish extraction, she preserved to the end of her fe some of the characteristics of her nationality, otably readiness in conversation and a sharpness n repartee.

Mrs. Bent accompanied her husband and gave im valuable assistance in his many journeys of archæological exploration. Their first important expedition was in the Aegean Islands in 1885–86 and 1886–87. In the latter year Bent was excavating in Thasos under the auspices of the Society for the Promotion of Hellenic Studies. Journeys to Asia Minor in 1888 and to the Bahrein Islands in the Persian Gulf in 1889 were followed by their best-known expedition in 1891, when they visited South Africa to study the ancient ruins at Zimbabwe in Mashonaland, then examined and measured systematically for the first time. The results of the expedition were embodied in "The Ruined Cities of Mashonaland" which appeared in 1892. Bent held the view that the builders of Zimbabwe were a northern race from Arabia, and for the rest of his life—he died in 1897—their expeditions had as their object to discover traces of such a race. They visited Abyssinia and the southern part of Arabia, of which they made a special study, visiting the almost unknown Hadramut country. Their last journey was through the Vafei and Fadhli countries in March 1897, Mrs. Bent giving an account of this journey to the Royal Geographical Society.

Mrs. Bent was an experienced photographer, as well as an accurate observer, as was shown by the book "Southern Arabia", published in 1900, which was written mainly by her with the aid of her husband's journals. One book which she wrote apart from her husband was "Anglo-Saxons from Palestine", published in 1900, in which she showed herself an adherent of the Anglo-Israelite theory.

WE regret to announce the following deaths:

Mr. A. B. Bruce, formerly of the Indian Civil Service and of the Ministry of Agriculture, on July 2.

Prof. L. T. Hobhouse, Martin White professor of sociology in the University of London, on June 21, aged sixty-four years.

News and Views.

AN honorary fellowship of the British Academy—a gnal distinction—has been added to the many cademic honours which have been conferred on that eteran scholar, Prof. A. H. Sayce. He has also been warded the Huxley Memorial Medal of the Royal nthropological Institute for 1929, and invited to eliver the Institute's Huxley Memorial Lecture in 930. Prof. Sayce's long career—he is now in his ighty-fourth year, and has been a fellow of Queen's ollege, Oxford, since 1869—is a remarkable record f scholarship, both in the study and in the field. 'or to the long list of books and articles from his pen ealing with the archæology of the Near East, especi-lly as related to Biblical archæology, must be added is work as an explorer and excavator in Asia Minor, gypt, and other countries of the East which bear pon his special studies. His work in the decipher-ent of cuneiform and Hittite inscriptions will always e a monument to British scholarship in this branch f study. Yet notwithstanding the highly specialised haracter of his studies, his interests have always emained wide, as was shown by the "Reminiscences" ublished in 1923. It was probably a surprise to most of his readers to learn that he was nearly shot as a spy in the Franco-Prussian War of 1870.

THE Kelvin Medal Award Committee, consisting of the presidents of the leading British engineering institutions, after consideration of representations received from leading engineering bodies in all parts of the world, has awarded the Kelvin Medal for 1929 to M. André Blondel. The medal is awarded as a mark of distinction in engineering work and investigation of the kinds with which Lord Kelvin was especially identified. M. Blondel, as engineer of the Ponts et Chaussées since 1889 and for many years the chief engineer of the French lighthouse services, is distinguished by his work on signalling apparatus, both optical and electrical, and particularly for his investigations in connexion with electrical measuring apparatus and photometry. In 1913 he was elected a member of the Paris Academy of Sciences, and in 1923 was appointed Inspecteur Général des Ponts et Chaussées. M. Blondel is an honorary member of both the British and American Institutions of Electrical Engineers. This is the fourth triennial award

of the medal, which has in previous years been given to Dr. W. C. Unwin (Great Britain), Prof. Elihu Thomson (U.S.A.), and the Hon. Sir Charles Parsons (Great Britain).

THE new laboratory at the University of Sheffield for research on the cold-working of steel, opened on July 6, has been established in consequence of a generous gift from the Worshipful Company of Ironmongers of London, which made a grant of £800 a year for seven years to endow a fellowship and two scholarships in the cold-working of steel. To make this gift available, the firms connected with the cold-working industry have, through the Cutlers' Company of Hallamshire, presented the University with the necessary plant. The new laboratory will be attached to the metallurgical and engineering departments of the University, and will be controlled by the professors of those subjects assisted by a committee on which the Ironmongers' Company, the Cutlers' Company, and the industry will be represented as well as the University. The University is greatly indebted to Mr. Percy Lee, Master Cutler of last year, to whose initiative and energy the establishment of the laboratory is due.

THE mechanical equipment of the new laboratory includes a wire and bar drawing plant constructed by Messrs. George Crossley, Ltd., of Cleckheaton. Having a two-speed gear and variable speed motor, wire drawing speeds of from 28 to 360 feet a minute may be obtained, and wires can be drawn of all sizes up to $\frac{5}{8}$ in. diameter and rods up to 1 in. diameter. The heavy drawing block is fitted with a friction clutch drive and capstan type pull-in gear, which is also used for drawing steel bars, for which purpose a specially strong die stand is fitted at the end of the bench. The light wire block is fitted with the ordinary creeper drive, using spring shock-absorbing cushions. Capstan type pull-in gear is provided. The motor can develop 20 h.p. throughout its range of speed. The rolling mill plant has been constructed by Messrs. W. H. A. Robertson and Co., Ltd., of Bedford. It has hardened steel rolls of 10 in. diameter and 10 in. face, and is fitted with two-speed gear box and variable speed motor, giving a range of rolling speeds from 60 to 300 feet a minute. The motor is capable of developing from 50 h.p. at 570 r.p.m. to 120 h.p. at 1260 r.p.m. The lubrication is by Messrs. Robertson's patent 'Flood' system. Water cooling is provided for the rolls and roll bearings and for the oil in connexion with the lubrication system. An alternative set of rolls is fitted with 'Skefko' double roller bearings. The research laboratories of the Department are well provided with appliances for mechanical and physical testing of the cold-worked material, including a complete outfit for the study of deformation by the X-ray method.

THE *Bulletin* of the Physical Society for May contains abstracts of the papers communicated and the remarks made at the discussion on the teaching of geometrical optics held on April 26. Nearly thirty members took part, some engaged in teaching the subject in schools, others in university or technical colleges, and a few engaged in designing or constructing optical instruments. On the question of sign convention, there appears to be wide differences of opinion; some teachers take distances as positive when measured with the light stream, others positive against the stream; some make a converging lens have a positive, others a negative, focal length. The designers all appear to use the analytical geometry method, and in conformity with industry make the focal length of a converging lens positive. These sign conventions are the great stumbling-block in the way of pupils, one speaker stating that in a recent school examination 240 out of 244 candidates made mistakes of sign in a simple lens question.

THE vergence or convergence method of dealing with lens problems, which has been used in several German and at least one English book for thirty years or more and is free from many of the difficulties as to sign, was mentioned by one teacher only. The wave surface method introduced forty years ago was advocated by three teachers and by several speakers holding non-teaching posts, but was considered unsuitable by the majority of the school teachers. Many speakers stressed the necessity of bringing the pupil, whether in school or college, into contact with modern optical instruments. It must be very unsatisfactory to school teachers of the subject to find how frequently their pupils fail to understand the sign convention they use, and it is to be hoped that one result of the discussion will be the general adoption of some method which will produce better results than those brought before the meeting.

ON Monday, July 8, an interesting collection of exhibits was opened at the Science Museum, South Kensington, to illustrate the history of the famous Rainhill locomotive trials on the Liverpool and Manchester Railway, the centenary of which falls in October of this year. The three outstanding dates in the early development of the world's railway systems are Sept. 27, 1825, when the Stockton and Darlington Railway was opened; Oct. 6, 1829, when the competition between the *Rocket*, *Sans Pareil*, *Novelty*, and *Perseverance* began on the Liverpool and Manchester Railway; and Sept. 15, 1830, when that line was officially opened. The collection of engines and models in the locomotive section of the Museum is well known, but during the next four months additional exhibits, including portraits, models, drawings, and letters, will be shown, while the Museum authorities have constructed a full-scale model of Ericsson's *Novelty*, and Mr. Henry Ford is kindly lending the working copy of Stephenson's *Rocket* which he has had constructed for his Museum at Dearborn, Michigan, U.S.A. Railways came into use two hundred years ago; Trevithick made the first steam locomotive in 1804, Blenkinsop's engines were running in 1812, Hedley's *Puffing Billy* was built in 1813, and Stephenson's first engine in 1814. By 1829 about fifty locomotives had been made in England; two, which would not go, in Germany; and one, a mere model, in America. Even in 1829, however,

here was a difference of opinion about the merits of he locomotive, but the Rainhill trials settled the uestion once for all. The exhibition just opened hould prove of great interest to teachers giving lessons n industrial development.

A FURTHER contribution to the history of the ship as made by Sir Westcott Abell in a paper read at Newcastle on July 2 to a joint meeting of the North-East Coast Institution of Engineers and Shipbuilders nd the Institution of Engineers and Shipbuilders in cotland, entitled "The Story of Safety at Sea". Dealing with his subject under the headings freeboard egulations, subdivision into watertight compartments, nd life-saving appliances, he referred to the loading narks placed on the sides of vessels by the Venetian uthorities so early as A.D. 1000, and an appendix ives a chronology of safety regulations. The modern istory of the subject, however, begins with the action f the Committee of Lloyd's and the Liverpool Under-riters, who, about 1835, proposed rules governing ree board. The important work of the Royal Com-ission of 1873 came through the action of Plimsoll, ho took up the cause of sailors in unseaworthy ships, n the House of Commons. The various committees hich have sat under the guidance of Sir Edward Reed, Sir Philip Watts, Sir Edward Harland, and Lord Charles Beresford have dealt with various aspects of he matter; the First International Conference on the afety of Life at Sea was held in 1913, and the second net in April and May last. The latter was attended y representatives from fourteen maritime countries nd four Dominions and Colonies, and regulations were greed to for the subdivision and construction of ships s well as for life-saving appliances, navigation, and ireless. In some tabular matter accompanying his aper, Sir Westcott Abell states that the average umber of vessels lost annually during 1905–14 was 4, while the average during 1920–27 was only 18.

THE only paper read at the recent summer meeting f the Institution of Mechanical Engineers, held at Manchester on June 24–28, was that by Mr. R. W. Bailey on "The Contribution of Manchester Re-earches to Mechanical Science." Beginning with a eference to the work of Dalton, Mr. Bailey reviewed t some length the epoch-making investigations of oule on the mechanical equivalent of heat, and then assed on to the researches of Fairbairn, who was "a orn engineer, possessing all the qualities necessary for he execution of large enterprises, and although, per-aps, of limited technical attainments, he appreciated nd was able to employ them in others". Fairbairn's ollaborators included Eaton Hodgkinson and the athematician Thomas Tate. Hodgkinson's own work n cast iron is among the classics of engineering re-earch. The concluding part of the paper was devoted o the work of Osborne Reynolds, who, like Dalton and oule, "possessed the philosophic mind and a gift or demonstrating or investigating a phenomenon by imple and ingenious experiment". The full import f Reynolds's researches is only now adequately ap-reciated. Mr. Bailey also gave a sketch of the esearches conducted in the mechanical engineering departments of the University of Manchester and of the Manchester Municipal College of Technology. The paper as it has been published is illustrated by photographs and drawings, and contains a bibliography which in itself affords ample evidence of the great value of the research work done in the district.

MR. E. C. SNELGROVE completes an interesting account of two important irrigation schemes in the Bombay Deccan in *Engineering* for June 21. The first is on the River Pravara and the second on the River Nira, both of which rise in the Western Ghats. The scheme on the Pravara River included the erection of the Bhandardara Dam for impounding water in Lake Arthur Hill, while that on the River Nira included the erection of the New Bhatgar Dam for storing water in Lake Whiting. The rainfall on the Ghats reaches as much as 250 in. per annum, but it is confined to the four monsoon months. The Bhatgar Dam, which took sixteen years to build, is by far the biggest masonry dam in the world, while the Bhandardara Dam is only exceeded in height by the Pacoima Arch Dam, California. The Bhandardara Dam is 1663 feet long, 278 feet high above the lowest foundation, and cost £560,000, while the storage capacity of Lake Arthur Hill is 10,086 million cubic feet. The Bhatgar Dam, replacing an older dam of the same name, is 5333 feet long, 190 feet high, and contains 21½ million cubic feet of masonry, or nearly 3½ million cubic feet more than the Assuan Dam; it cost £1,170,000. Mr. Snelgrove compares the cost of these three great dams, and says that 100 cubic feet of masonry in the Bhandardara Dam cost £4, 13*s.* 4*d.*, in the Bhatgar Dam £5, 10*s.*, and in the Assuan Dam £12, 17*s.* 4*d.* He also says that protecting the land by irrigation increases its value by 200 per cent, and that while charges for water have increased by less than 40 per cent, the value of crops has increased by about 85 per cent.

THE *Himalayan Journal*, of which the first number is dated April 1929, is a periodical that is to be published from time to time by the Himalayan Club. This club, designed to bring together all those interested in travel and exploration in the Himalaya, was suggested so long ago as 1866, but the actual foundation dates from 1927. The club exists "to encourage and assist Himalayan travel and exploration, and to extend knowledge of the Himalaya and adjoining mountain ranges through science, art, literature, and sport". At its start it amalgamated with the Mountain Club of India, the foundation of which was contemporaneous. The club hopes to prepare route- and guide-books as well as scientific monographs. It has found temporary accommodation in the office of the Survey of India at Simla. The *Himalayan Journal* is edited by Major K. Mason, and contains a dozen important articles illustrated with photographs and maps. They include articles by Mr. F. Ludlow on the Shyok Dam in 1928; by Major K. Mason on the Indus floods and the Shyok glaciers; and by Mr. Kingdon Ward on botanical exploration in the Mishmi Hills. News of various

expeditions are also given. The journal has started with a high standard of achievement which promises well for future issues.

IN *A.E.G. Progress* for May an interesting account is given of a floating Diesel-electric power station. This station was built specially to help in the construction of a lock on an inland waterway near Berlin. The station is of 500 horse-power, and work on the lock has been proceeding continuously for the last eighteen months. Any disturbance to the smooth working of the water pumps used for draining would be very serious and would involve a heavy loss. In colonial countries, new power stations are sometimes erected on building sites of a swampy nature. In this case the outlay for the machine foundations is very costly. As the probable demand also is difficult to estimate, it seems to us that a floating power station would be very useful. It could be anchored in a river or in a sheltered sea bay, and the electrical possibilities of the site could be explored in a year or two and the ideal site for an electric power station to serve the neighbourhood determined. The advantages of a Diesel-electric unit are that it can be started almost at once and is always ready for service. These units can also be erected on pontoons. With four cylinder engines the vibration is noticeable but is not objectionable.

THE non-magnetic ship *Carnegie* left Yokohama on June 24; she is due at San Francisco about July 29. The vessel was at Pago-Pago, American Samoa, on April 1–5, and at Apia, Western Samoa, on April 6–20. Passing close to Wake Island on May 11, the vessel arrived at Guam on May 20 and left for Yokohama on May 25. The oceanographic observations are constantly developing new bottom features; among these was the discovery of a new deep which was named "Fleming Deep" by Captain Ault, the maximum depth recorded being 8650 metres at lat. 23·8° N. and long. 144·1° E. While in Western Samoa and in Japan the magnetic standards of the Apia and Kakioka observatories were compared with those of the *Carnegie*. Celebrations of the twenty-fifth anniversary of the research activities of the Carnegie Institution of Washington are to be held on board the *Carnegie* in San Francisco Harbour on Aug. 26, 27, and 28, just before her departure late in August for Hawaii, Samoa, and New Zealand.

AT its annual business meeting, held at Worthing last week, the Museums Association elected Dr. F. A. Bather as an honorary member in recognition of his distinguished museum work and of his services to the Association as president, as editor, and in other ways during the forty years of its existence.

THE earthquake which was felt in Gloucestershire on Tuesday, July 2, was recorded at Kew Observatory as an extremely small disturbance, which commenced at 20 hr. 27 min. 32 sec. G.M.T., and lasted about 30 sec. Five considerable earthquakes were recorded at the Observatory during the three days July 5–7. Four of these had epicentres in the North Pacific. The fifth, which occurred on the morning of July 6, originated in the Atlantic Ocean off the coast of Brazil.

THE Newcomen Society will hold its summer meeting jointly with the Devonshire Association at Dartmouth on July 23–26 to commemorate the bicentenary of the death of Thomas Newcomen. During the meeting a small collection of Newcomeniana will be on view in the Mayor's Parlour at the Town Hall. Wreaths will be laid on the Newcomen Memorial on July 23, when Mr. L. St. L. Pendred, president of the Newcomen Society, will deliver a eulogy, and Dr. G. P. Bidder, president of the Devonshire Association, will give an address on the same evening. Eng.-Capt. E. C. Smith is to deliver a public lecture on "Thomas Newcomen: Two Hundred Years of Steam Power" on July 25, and various local excursions have also been arranged. The honorary secretary of the Newcomen Society is Mr. H. W. Dickinson, Science Museum, South Kensington, London, S.W.7.

IN our issue of June 15, p. 926, in a paragraph on "Chemical Apparatus", it was stated that Messrs. Griffin and Tatlock, Ltd., combine the former business of John J. Griffin and Sons, Ltd., and Baird and Tatlock, Ltd. While this statement is perfectly correct, we are asked to point out that Messrs. Baird and Tatlock (London), Ltd., are not concerned in this merger.

Two very useful catalogues of science books have just been issued by Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. They range respectively over the subjects of mathematics, physics, astronomy, and the history and method of science, and botany, zoology, agriculture, and geology, and will be of service for reference. They can be had free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior lecturer in applied mathematics in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (July 15). A visiting teacher of heat engines, at the L.C.C. School of Engineering and Navigation, High Street, Poplar, E.14—Education Officer (T.1a), The County Hall, Westminster Bridge, S.E.1 (July 15). Two temporary junior engineering assistants and a temporary architectural assistant—The Chief Engineer, Metropolitan Water Board, 173 Rosebery Avenue, E.C.1 (July 15). An assistant lecturer in pathology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (July 15). A senior lecturer in chemistry at the Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth (July 16). A science master, with special qualifications in agricultural science, under the Magherafelt Regional Education Committee, Co. Londonderry—The Principal and Executive Officer, Technical School, Magherafelt, Londonderry (July 16). A taxidermist and preparator of specimens in the Auckland (New

ealand) Institute and Museum—The High Commissioner for New Zealand, 415 Strand, W.C.2 (July 0). Assistant civil engineers in Civil Engineer-in-hief's Department, Admiralty, and H.M. Naval stablishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (July 20). n assistant lecturer in zoology—The Registrar, niversity College of North Wales, Bangor (July 20). junior physicist at the Building Research Station, arston, nr. Watford—The Secretary, Department Scientific and Industrial Research, 16 Old Queen reet, S.W.1 (July 20). A demonstrator in zoology the Royal College of Science—The Secretary, mperial College of Science and Technology, South ensington, S.W.7 (July 23). A student probationer oologist or physiologist)—The Director, Marine iological Laboratory, Plymouth (July 25). A curator radium at the General Hospital, Birmingham—he House Governor, General Hospital, Birmingham uly 25). A lecturer in geology at Armstrong llege, Newcastle-upon-Tyne—The Registrar, Armrong College, Newcastle-upon-Tyne (July 27). An sistant chemist (woman) for the Air Ministry, Kidooke — The Secretary (I.G.), Air Ministry, W.C.2. physico-chemist at the Indian Lac Research stitute, for research work in the problems conected with harvesting, storage, manufacturing, d packing lac and shellac — "India", care of Messrs. Richardson and Co., 26 King Street, St. James's, London, S.W.1. A visiting lecturer in engineering science and a full-time chemistry master at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A full-time teacher of general engineering subjects at the Acton Technical Institute—Mr. J. E. Smart, Municipal Offices, Acton, W.3. A part-time instructor in mechanical engineering at the Watford Technical School—The Principal, Technical School, Watford. Pathologists in Nigeria on the West African Medical Staff—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An assistant experimental officer for design duties at the Government experimental establishment, Biggin Hill, Kent—The Secretary, R.E. Board, 14 Grosvenor Gardens, S.W.1. An expert in animal husbandry, and a director of the Agricultural Research Institute, Pusa, India—The Under-Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1. Two junior assistants, one in physics and one in chemistry, under the British Boot, Shoe, and Allied Trades Research Association—The Director of Research of the Association, 19 Bedford Square, W.C.1. A biologist at the Rothamsted Experimental Station for research work in general microbiology—The Secretary, Rothamsted Experimental Station, Harpenden.

Our Astronomical Column.

New Minor Planet.—A planet, the provisional signation of which is 1929*KA*, was recently disvered at Heidelberg; it had the unusually rapid otion of 27′ northwards per diem. Dr. G. Stracke ves an ephemeris in *Beobachtungs-Zirkular*, No. 23; magnitude is now 13·3 and is slowly diminishing. e states that the rapid motion arises from a comnation of great eccentricity and high inclination, the net being now near perihelion. Its position on ly 16 is R.A. $16^h\ 32^m{\cdot}0$; N. Decl. 5° 3′. It is then rly stationary in R.A. and is moving north 5′ daily.

Solar Activity.—Observations of sunspots and ulæ for the first half of 1929 show that the sun's ivity is definitely declining towards minimum, ich may be expected in about four years' time. another indication of the progress of the 11-yr. ar cycle, it may be noted that the shape of the ona seen during the total eclipse of May 9 last was intermediate type. Although the sun's activity is sening, occasional large sunspots may be expected. the preceding cycle, for example, the most extensive eam of spots seen for nearly half a century occurred 1920, three years after the maximum. A couple of ge spots have recently been seen together on the c, nearly on the same meridian but on opposite es of the sun's equator. Both were visible to the ked eye for a few days. Particulars of these spots given in the following table in continuation of t given in NATURE of Mar. 16, p. 425:

Date on Disc.	Central Meridian Passage.	Latitude.	Area on June 24.
June 18–30	June 24·0	9° S.	1/1350
June 18–30	June 24·5	13° N.	1/2000

(Areas express proportion of hemisphere covered.)

Catalogue of the Comparison Stars for Eros.—It is only a year and a half before the very near proach of Eros to the earth in January 1931. Prof. Kopff prepared a list of stars suitable for use as comparison stars on this occasion; many observatories have co-operated in observing them. Prof. P. Stroobant, Director of the Uccle Observatory, is one of the first to publish results. In Tome 2, Fascicule 2, of the *Annals* of the Observatory, he publishes the positions of about 400 stars, lying between north declinations 19° and 48°; these are the stars needed for the earlier portion of the apparition; Eros goes later into south declination, and the observation of the southern stars is more difficult for northern observatories. The magnitudes of the stars observed at Uccle range from 7·0 to 9·6. Some were observed eight times; a few were observed once only, but by co-operation of observatories good positions should be available.

Russian Society for the Study of the Universe.—The report for 1928 just issued by this Society gives details of remarkable activities shown in various branches of astronomical research. The number of members was 604, and 29 meetings took place. As an example of the work of the observing sections, it may be mentioned that 23 observers pursued solar inquiries and sent in 1789 drawings of groups and spots. Variable stars attracted 20 members, who obtained 7600 observations. The meteoric field had 30 observers, who gathered 17,200 records. The results obtained in the various departments appear to be of excellent character and extensive in amount. Fifteen volumes have been published by the Society, and the last one issued comprised 390 pages. Branches of the Society have been formed in the provinces, and these have already proved very successful in their work, as being of considerable assistance to the parent organisation at Leningrad. The marked increase in the number of members and subjects under investigation gives promise of the accomplishment of much useful research in various fields of astronomy.

Research Items.

Anatomy of Seals.—The structure of seals has been the subject of various memoirs, but none has been so thoroughgoing as A. Brazier Howell's account of the comparative anatomy of the eared and earless seals (*Proc. U.S. Nat. Mus.*, vol. 73, art. 15, 1928). The investigation is based upon *Phoca hispida* as representing the earless and *Zalophus californianus* the eared seals, but comparative references to the work of other anatomists are included. A few general results only can be mentioned. In spite of the efforts which have been made to link eared and earless seals with land mammals of the bear and otter tribes, Howell regards the evidence to be so indefinite as to preclude any reasoned conclusion as to ancestry. The methods of swimming now employed by the two groups of seals are fundamentally different, but many of the characters common to both may be largely due to convergence, although on the whole the earless seals exhibit in such characters a somewhat greater divergence from fissiped conditions than the eared. On the other hand, there are characters, such as the telescoping of the skull, the cartilaginous extensions of the digits, and the flatter phalanges, which suggest that *Zalophus* may have travelled further from the typical terrestrial carnivore. In both groups there are hints of structures in the limbs which suggest that a certain amount of retrogressive evolution may have taken place, *Phoca* at one period having perhaps made more use of its fore limbs, *Zalophus* of its hind limbs. But this suggestion requires more evidence and is put forward tentatively.

'Knothead' Carp.—Mr. David H. Thompson has investigated the causes of deformed carp in the Illinois River (State of Illinois Department of Registration and Education, Division of the Natural History Survey, *Bulletin*, vol. 17, art. 8, 1928). The carp of the Illinois River are of considerable importance commercially and the 'knothead' malformation is well known. The fish have bulging opercles, narrowed skull, and sunken cheeks, besides other irregularities, are pronouncedly sluggish in habit, and smaller than the normal form. Investigation of the gills showed a reduction of lamellæ and an altogether less effectual breathing apparatus than is shown in the ordinary healthy fish. No parasites were present nor other infection, but the flesh was very soft. It was found that these deformed individuals inhabit those parts of the river which are polluted largely by sewage with a consequent reduction of green algæ, and that there is apparently a direct relation between this reduction of algæ, containing vitamin D, and the malformed fish. It seems probable that the malformation is due to some external influence which has interfered with the developmental processes or the metabolism of the fish and has altered their growth form. The author concludes from his researches that the 'knotheadedness' is a disease similar to rickets in the higher vertebrates, due to lack of vitamin D. Other fishes of the area are not affected, probably because they are less tolerant of pollution than the carp and feed in the cleaner backwaters. Interesting radiograms are given of the heads of the normal and 'knothead' carp.

Development of a Hexactinellid Sponge.—Y. Okada describes (*Jour. Fac. Sci. Imp. Univ. Tokyo*, vol. 2, 1928) the development of a hexactinellid sponge, *Farrea Sollasii*. Material was obtained by monthly dredgings at about 150 fm. in the Sagami Sea. The author considers that the breeding period extends throughout the year. The oocyte is at first scarcely distinguishable from an archæocyte, but later becomes larger and lies in the outer trabecular layer of the sponge. After fertilisation it appears to migrate into the inner side of the trabecular layer and takes up its position near the wall of a flagellated chamber, where it undergoes its early development. The first two cleavages at least are total and equal. The blastula is planula-like, at first nearly spherical but later oval. The youngest embryo found in the trabecular layer consists of an outer layer of closely packed cells and a central mass of jelly-like substance containing numerous amœboid cells which have wandered in from the outer layer. Six stauractin spicules are present. In a later stage with twelve spicules, flagellated chambers appear in the central mass—each chamber is due to the amœboid cells having become rounded and arranged round a central cavity. Coincident with the formation of flagellated chambers an invagination appears on the surface of the young sponge—probably the commencement of the communication between the chambers and the exterior. The collars and flagellæ probably develop after the embryos are set free. The development of the spicules is described. The six rays of the hexactin do not grow in a single cell as in other siliceous sponges but from a syncytial scleroblast mass. The nuclei of this mass are more than six and bear no definite relation to the rays. The hexactines originate as such.

***Echinococcus* in New South Wales.**—Ian Clunies Ross records (*Sydney University Reprints, Series* I, Agric. and Vet. Sci., 1927) the results of an investigation into the occurrence and distribution of *Echinococcus granulosus* (*Taenia echinococcus*) in New South Wales. Of 18 cattle examined, six were infected with hydatids (two in the liver and four in the lungs); of 123 sheep 41 were infected (liver 12 times and lungs 33 times). Of twenty-three dogs examined at the slaughter yards in four country districts, seven were infected with the worm, but more than one hundred dogs from the city and suburbs of Sydney were examined and no infestations were observed. The records of four district hospitals chiefly between 1911 and 1924 show that out of about 19,000 patients 71 were infected with hydatids. In a south coast district there were ten persons infected with hydatids in a total of 1370 in-patients at the local hospitals. In man, cases of hydatid in the liver greatly outnumber those in which the lungs are affected.

Hawaiian Non-Marine Mollusca.—The molluscan fauna of Hawaii has been studied for many years, but the literature is very scattered. Mr. E. L. Caum has, therefore, rendered very real service in compiling a "Check List of Hawaiian Land and Fresh Water Mollusca" (*Bernice P. Bishop Mus. Bull.*, 56). This list is systematically arranged with abbreviated references to sources for which a key is supplied at the end, and also an alphabetical list of all the names from orders to species, exclusive of synonymous generic names. It is a most valuable piece of bibliographical work, and more such are wanted.

Removal of Chlorosis in Fruit Trees.—The phenomenon of chlorosis (or scarcity of chlorophyll) is not uncommon on calcareous soils, and it is generally recognised that it is usually due either to scarcity of available iron or to immobility of this metal in the plants. In commercial practice it is not always easy to remedy the condition. This is most often done by spraying with iron salts, and more than half the pineapple crop in Hawaii has to be treated in this way.

Wallace (*Jour. Pomology and Hort. Sci.*, **7**, 251-260), ntinuing his investigations on chlorosis of fruit ees, now finds that much more certain improvements n be produced by growing cover crops over the ots of the affected trees. Any danger of nitrogen arvation can be removed by suitable fertilisers.

Non-Dehiscence of Stamens in Punjab-American ttons.—This phenomenon, which was observed by evor Trought, the Cotton Research Botanist at allpur, and is described in the *Memoirs* of the Dertment of Agriculture in India, Bot. Ser., vol. 17, o. 1, 1928, may prove of general importance, as der these conditions the flowers are not fertilised, d are shed after a few days. With American cotton the Punjab at certain times of the year the anther every stamen fails to open. In this preliminary per the cause for this failure to dehisce is left open, t the author is evidently inclined to attribute it to failure of the pollen grains to swell up to their rmal size at maturity. Incidentally, he gives asons for thinking that the text-book mechanism dehiscence through the hygroscopic qualities of e wall of the fibrous layer does not account for the rmal dehiscence of the anthers in cotton.

A Haploid Tomato.—In the last few years, haploid utations or plants with a single set of chromosomes ve occurred in the experiments of several different vestigators. A haploid *Datura* arose in 1922 among e offspring of certain plants which had been subcted to cold, by Blakeslee. Other cases have been scribed since in tobacco (*Nicotiana tabacum*), wheat *riticum compactum*), *Solanum ringrum*, and *Crepis pillaris*. These have usually occurred in the F_1 neration of a species-cross involving more or less erility. A haploid tomato mutant has recently been scribed by Lindstrom (*Jour. of Heredity*, vol. 20, o. 1). It appeared in the F_2 of a variety cross in nich there was complete fertility. It was dwarf, th shorter, thinner stem, much smaller leaves and wers, and almost completely sterile, since its twelve romosomes had no mates. In the pollen mother lls there is no attempt at pairing of the chromosomes, d they separate in various irregular ways. In the ot tips, occasional cells had the diploid number. uttings made from the original plant through six nerations of cuttings numbering more than 300 ants have shown no fertility and no reversion to the ploid number of chromosomes. It may be signifint that, of the six haploid mutants now known, all t two belong to the family of the Solanaceæ.

Annual Periodicity of Earthquakes.—In a paper blished in the recent number of the *Bulletin* of the ismological Society of America (vol. 18, pp. 246-6; 1928), Dr. C. Davison considers the annual riodicity of earthquakes in relation to geographical nditions and the intensity of the shocks. It is own that, throughout the vast continental areas of th hemispheres, the maximum epoch of the annual riod in earthquakes of semi-destructive or less insity falls during the mid-winter months. These eat areas are, however, fringed by certain insular d peninsular regions in parts of which the maximum och is reversed. On the other hand, the annual riodicity of great destructive earthquakes in either misphere is independent of geographical conditions. e maximum epoch occurs in the summer months, ether the regions are continental, peninsular or ular.

Miocene of Northern Colombia.—The marine Mioe strata of northern Colombia, now described by F. M. Anderson (*Proc. Calif. Acad. Sci.*, Ser. 4, vol. 18) extend eastwards from the Gulf of Urabá along the Colombian coast to the Sierra Nevada de Santa Marta and are found again near Rio Hacha, whence they extend southwards into the valley of the Rio Cesar. The author briefly describes the several subdivisions and considers that they correspond fairly well on the whole with those of Santo Domingo. Of the fossil contents, 170 species of Mollusca and three Foraminifera are enumerated, almost without regard to any scheme of taxonomy. Thirty-seven new species and one new name are included and figured on sixteen very good plates.

Post-Tertiary Marine Mollusca of Oahu.—Limestone formations fringe the shore line of the Hawaiian island of Oahu above tide mark and extend for miles inland. From a study of their fossil contents, J. M. Ostergaard considers that their age is not greater than the Pleistocene (*Bernice P. Bishop Mus. Bull.*, 51). Details of the twenty-two collecting stations are given and their positions shown on a text map, with a table of the fossil occurrences at them. Eighty-two species and subspecies of mollusca were determined, of which three are presumably extinct. These last, as well as some forms living elsewhere than at Hawaii, are fully described and figured. The author discusses certain problems concerning the distribution of Indo-Pacific forms and concludes, in view of the fact that many species now found thriving best in the warmer Indo-Pacific are represented in Hawaii by fossils only, and others by species on the border of extinction, that when the limestone was forming Hawaii had a higher ocean temperature.

Oil-fields of Burma.—Dr. L. D. Stamp has been indefatigable in his efforts to make known more widely the oil geology of Burma, which, it must be admitted, since the well-known publications of Sir Ernest Pascoe, has been somewhat of a closed book to all save those concerned with actual developments. Two years ago Dr. Stamp dealt with the conditions governing the occurrence of oil in this territory; this was followed last year by his paper on the connexion between structural features and commercial oil deposits, in which Burma also figured prominently; and now we have a paper on the actual oil-fields themselves, read to the Institution of Petroleum Technologists on April 9. It is creditable to the author that he has been able to deal with his data in such a way that there is comparatively little overlap between the three papers, though one wonders why he did not present this last subject as a natural continuation of the first, as most of the facts must have been available to him at that time. However, this discussion of the chief oil-fields and their geology is timely and will be useful to students and others who have long felt that some authoritative account of this important oil-producing region of the British Empire should be available, particularly as the official volume referred to was published so long ago as 1912. The account of the oil-fields is not only technical, but also economic, and in every case an interesting summary of developments by the varied interests concerned is given. The author expresses the opinion that, while existing fields in Burma have prospects of good reserves and long life, there are small hopes of extensive new fields.

Ozone in the Atmosphere.—In *Smithsonian Miscellaneous Collections*, vol. 81, No. 11, 1929, F. E. Fowle discusses measurements of the ozone content of the earth's atmosphere made at the Smithsonian solar radiation observatories. Cabannes and Dufay showed in 1926 that the published coefficients of

atmospheric transmission obtained by Smithsonian observers revealed ozone absorption in the Chappuis band (4500-6500 A.) in the visible spectrum, in remarkable agreement with the characteristics of this band as measured by Colange in the laboratory. Fowle has applied this method to the original observations, in more detail than was possible with the published data alone. He is thus able to examine the amount and variation of ozone at the Smithsonian stations, using data totally independent of those on which the work of Fabry, Dobson and their collaborators is based, since the latter refers to the Hartley band (2300-3100 A.). For Table Mountain results from both methods are available; they agree in the mean values, and the variations found in the two ways are closely correlated, but those obtained by Fowle's reductions are the greater. Further, Fowle finds a distinct correlation between ozone content and the annual mean sunspot number for the northern stations, though not for Montezuma in Chile; Dobson found very little connexion of this kind. Fowle raises the question whether the ozone absorbing in these two bands may be in different molecular states, produced by different agencies and possibly situated in separate layers of the atmosphere.

Infra-Red Spectra.—The first two papers by Dr. E. K. Rideal and his collaborators in a projected series on infra-red spectra appear in the June issue of the *Proceedings of the Royal Society*. In the first, by C. P. Snow and A. M. Taylor, a grating spectrometer is described, and the particular points to which attention had to be directed in its construction are set out. The chief of these are efficiency between 2 μ and 6 μ, dispersion and resolution sufficient to effect fine structure analysis of the order of one wave-number, and adaptability for absolute measurements of absorption. In the second, by F. I. G. Rawlins, E. K. Rideal, and C. P. Snow, an account is given of the results obtained in the investigation of the 5·3 μ band of nitric oxide with this instrument. The spectrum includes a Q branch, as would be anticipated from the gyroscopic nature of the molecule NO, which is of the odd-electron type, and has also the expected steady change in intensities in bands of low rotational quantum number. There is, in addition, close agreement between the magnitudes of the molecular constants as deduced from this part of the spectrum, and those obtained from the electronic band-spectra, the two values given for the moment of inertia of the normal molecule, for example, being $1{\cdot}64 \times 10^{-39}$ gm. cm.^{2} and $1{\cdot}63 \times 10^{-39}$ gm. cm.^{2} respectively. Work is now in progress on the 4·7 μ band of carbon monoxide, and has already shown, contrary to a previous statement, that this does possess a fine structure.

Scattering of Electrons.—A paper by N. F. Mott in the June number of the *Proceedings of the Royal Society*, on the scattering of fast electrons by atomic nuclei, contains some interesting remarks on the physical significance of some of the quantities that enter into the equations of the new mechanics. The special problem considered is the existence of a spin axis in an electron. When the electron is part of an atom, it evidently cannot be dealt with individually. When it is free, on the other hand, the 'uncertainty principle' shows that the two obvious methods of testing for whether or not it has magnetic moment, namely, by the use of a magnetometer, or by the setting up of a Stern-Gerlach deflection apparatus, must also fail. There are, nevertheless, two constants in the mathematical expression for an electron which might be taken to define an axis, and the question becomes one of finding if these can appear in the solution of any experimental problem involving an electron in such a way as to be recognisable. Mr. Mott finds that this can be answered in the affirmative; when an initially unpolarised beam—that is, one in which the supposed axes are orientated at random—is scattered from two targets in succession, its intensity will be asymmetrical about the direction in which it falls on the second target, and this should be detectable experimentally. The actual formula which is derived for single scattering does not agree very well with the experimental results of Chadwick and Mercier, but it is possible that the discrepancy is due to the neglect of the radiative forces upon an accelerated electron.

Synthesis of an Isomeride of Thyroxine.—Since the constitution of thyroxine was elucidated in 1926, a number of its derivatives have been prepared and their physiological activity examined. The *Journal of the Chemical Society* for May contains an account of the preparation by Harington and McCartney of the preparation of $\beta\beta$-di(3 : 5-di-iodo-4-hydroxyphenyl)-α-aminopropionic acid

$$[(OH.C_6H_2I_2)_2CH.CH(NH_2).CO_2H],$$

which is isomeric with thyroxine. This substance differs from thyroxine in that the benzene rings are connected by a carbon instead of an oxygen linkage, but it retains the characteristic *o*-di-iodophenolic grouping. The new compound does not appear to show any physiological activity of the type exhibited by thyroxine.

Dissolution of Silver in Water.—According to a paper in Collection I., No. 3, of *Czechoslovak Chemical Communications*, Křepelka and Toul have found that pure silver dissolves slightly in distilled water and passes into solution in the form of silver ions. The greatest concentration of silver found by nephelometric measurements was 0·037 mgm. in 1000 c.c., and this amount was reached after about 21 days; further contact of the metal with water did not increase the concentration above this figure. When the surface of the metal had been reduced with hydrogen and the water freed from dissolved gases, the silver did not dissolve in sufficient quantity to be detected. It is concluded that the dissolution is due to a surface film of oxide or adsorbed oxygen, or to oxygen dissolved in the water. When the measurements were made using glass vessels, the amount of silver dissolved was about 0·003 mgm. more than when silver apparatus was employed. This difference is probably caused by alkalis from the glass.

A Transformation of Austenite into Martensite.—A paper by Dartrey Lewis, of more than usual interest, was presented at the recent meeting of the Iron and Steel Institute. A 0·8 per cent carbon steel may be quenched in a molten salt-bath at 232° C. to an austenite which is stable for at least five minutes. On subsequent cooling to room temperatures, the austenite is converted into martensite, the final hardness of which is practically independent of the rate of this cooling. Such a two-stage hardening should have commercial application in the treatment of steel since the quenching can be placed under full control and the rate at which the martensite is formed varied. Such treatment should be of value in the avoidance of quenching cracks and distortion. Further, the possibility is opened up of conducting forming operations at this temperature whilst the steel is still ductile, and then allowing the parts to harden on cooling in air.

Annual Conference of the Museums Association.

THE fortieth annual conference of the Museums Association, held at Worthing on July 1–5, was many respects the most successful in the history that body. The success was due to many favouring cumstances. The Royal Commission on National iseums and the Miers Report on Provincial Museums d awakened the interest of a wider public; hints om the Commission that the national establishments ght be helped to give more practical shape to their knowledged sympathy with the local museums, as ll as the bodily presence of two Carnegie Trustees th their secretary, roused the hopes of curators; e nearness to London enabled many busy people attend and contribute papers; and, above all, e choice of Sir Henry Miers for president promised practical address and a fruitful discussion.

A main object of the Association is to promote -operation between museums of every kind. Sir enry Miers took that as the subject of his address, d speakers had been chosen to approach it from rious sides. Sir Henry has in mind a museum rvice for the whole country, parallel to the library rvice that has cast a net which now gathers in en small villages. As driving force for such a heme he sees only the Museums Association. With all means the Association has already done much, t voluntary labour, manifesting its results only in e annual conference, the *Museums Journal*, and a w circulating collections, is no longer enough. A ntral office and a whole-time secretary are urgently eded, and to provide these more museums should me in. There is too much individualism and competition, too little co-operation and mutual aid between museums; the larger museums do not realise w much they stand to gain by helping their weaker ethren. Sir Henry indicated many openings for -operation, among them the guidance of archæological excavation, the interchange of loan exhibits, d the training of curators.

In the ensuing discussion, Dr. Cyril Fox extended e idea of co-operation to the overseas members, d showed how ethnographical material stored in r museums might now be of more use if returned the Dominions whence it came long ago; he suggested a central clearing-house for archæological jects. The Earl of Crawford, comparing museums, cture-galleries, and libraries, pointed out that the blic appreciation of museums called for greater ental effort; the three classes should be put on a vel, since each is necessary for intellectual progress. r. A. J. K. Esdaile urged the need of a central fice for arranging exchanges and exhibitions. Mr. ate Regan thought that junior members of museum affs should be welcomed to the Association at a smaller subscription but without the *Journal*. Dr. F. A. Bather replied that this would not help the juniors so long as their superiors did not encourage them to attend the Conference. As for a central clearing-house, the best course would be for each department of the national museums to receive and distribute its own class of material, but much could be done directly if use were made of the *Journal*. Other speakers advocated the extension of regional federations under the auspices of the Association.

The discussion was revived later by Dr. Hay Murray's suggestion that every large museum should adopt a small museum, and was carried further by Mr. Lawrence Haward's account of the scheme of loans initiated by the late C. Rutherston's bequest to the Manchester Art Gallery, by Major Longden's informative paper on exhibitions of foreign art, and by a most vigorous address from Dr. G. H. Locke, public librarian of Toronto, on co-operation between libraries and museums. Mr. Eric Maclagan here arrived to explain the kind of help the Victoria and Albert Museum could give to provincial museums, and reopened the discussion on training.

Most of the remaining papers dealt with the educational work of museums. Mr. Harold L. Madison, curator of education at the Cleveland (Ohio) Museum of Natural History, gave a thoughtful and instructive address on the work of his museum in connexion with schools. Miss Bertha Hindshaw related the efforts of the Ancoats Museum, Manchester, to get hold of the 'young visitor' from that poor district. Sir William Furse explained how he had managed to get the numerous small-scale panoramas which add so greatly to the attraction of the Imperial Institute Galleries. Mr. C. A. Siepmann, of the British Broadcasting Corporation, made a suggestive speech on the relations between broadcasting and museums, and this also provoked an animated discussion.

The more technical papers included a demonstration by Mr. W. E. Mayes of making wax models of plants, and notes by Mr. J. Ritchie on the preservation of ancient tempera paintings and on celluloid mounts for insects and herbarium specimens.

After so much time given to papers, the delegates enjoyed a visit to Tarring Cottages and Cissbury Camp, the latter admirably elucidated by Mr. T. Sheppard, and a whole-day excursion to Arundel Castle, Goodwood House, Chichester, Bignor Roman Villa (explained by Mr. S. E. Winbolt), and Petworth House. The remarkably smooth working of the excursions, as of all the other arrangements, was due to the organising capacity of the local secretary, Miss Marian Frost, of the Worthing Museum, aided by the ladies of her staff.

Biology of Norwegian Lakes.

BRAARUD, B. Föyn, and H. H. Gran, in a recent paper entitled "Biologische Untersuchungen einigen Seen des östlichen Norwegens August–ptember 1927" (Norske Videnskaps-Akademi i lo, I. Mathem. Naturvid. Klasse 1928, No. 2), report several lakes in the east of Norway with regard to e plankton and its environment. The work was rried on in a similar way, but for a longer period, the Hurdals-See in 1926, and the results published this same publication (1927). In the Hurdals-See e temperature, oxygen content, hydrogen ion concentration, and distribution of the plankton were vestigated at different depths from May to October, the preserved plankton centrifuged and estimated quantitatively side by side with living net-plankton estimated qualitatively, the result showing that most of the species were in largest numbers in summer with a maximum in August–September. Only *Dinobryon sertularia* formed a maximum in June.

The other lakes, and also the Hurdals-See again, were worked in August and September 1927 with the same methods and apparatus. The plankton of the Hurdals-See was poorer than in 1926, probably because of the very wet summer.

Amongst the nine lakes in question, the Haugatjern was distinctive in having large masses of plankton

made up of few species occupying the opaque upper layers, a strong oxygen deficit in the depths and below six metres, and definite differences in the hydrogen ion concentration between the upper and deeper layers. Such conditions can only be explained by a strong food stream from land. The plankton production of the Haugatjern is as much as 100 to 1000 times greater per surface unit than any of the other lakes. These lakes are different from one another in several ways, and the amount of plankton varies much in the different lakes. The renewing of the plankton food on which the plankton production depends comes either from the upper layers, by supply from land, or from the depths by vertical circulation. In those lakes where the flowing water in summer must always be comparatively poor in nourishment, the circulation of the food-stuffs for plankton production is more important than the supply from outside. In shallow lakes in summer a daily vertical circulation is possible by the warming of the bottom by radiation, and otherwise in spring and autumn layers are quickly mixed so tha maxima are formed of quick-growing planktoni species.

Such distinct maxima at special times of year ar to be expected, especially in shallow lakes. In th deeper lakes the circulation is slower and seasona maxima not so distinct. Thus the differences in th richness of the plankton in those lakes, other tha the Haugatjern, can probably be explained best b the fact that the relative richness in the shallowe lakes is conditional on a quick circulation of the food stuffs present.

The species which take part in the mass produc tion are few. They include Cyanophyceæ, Chloro phyceæ, Flagellata, Dinoflagellata, and Diatomaceæ The diatoms, especially *Asterionella gracillima* an Cyanophyceæ (*Anabæna flos aquæ* and *Cœlosphærium Nægelianum*), are very quick-growing. Of the dino flagellates, *Ceratium hirundinella* is universally pres ent, reproducing in masses in the Haugatjern.

Agricultural Afghanistan.[1]

THE Institute of Applied Botany (Leningrad) sent an expedition to Afghanistan in 1924, consisting of the director of the Institute, Prof. N. I. Vavilov, the engineer-agronomist, D. D. Bukinich, and the agronomist, V. N. Lebedev. The principal purposes of the expedition were: (1) To investigate and collect plants cultivated in the country; (2) to ascertain the regularities in the distribution of crops and their varieties over the slopes of the Hindu Kush; (3) to investigate the technique of local agriculture, the irrigation in particular; (4) to gather information as to the agricultural resources, especially as regards cotton-growing.

The expedition travelled about 6000 km., covering the whole territory of agricultural Afghanistan. The authors divide Afghanistan into six climatic regions: (1) Mountain regions with cold and temperate climate and well-marked differences between the seasons. (*a*) High mountain regions 2400 m. above sea-level, with 7-9 months of winter. This is the region of spring cereals, chiefly of irrigated crops. The highest altitudes are characterised by a dry desert climate. (*b*) Regions of temperate climate situated between 1300 m. and 2400 m. above sea-level. This region is chiefly characterised by irrigated winter wheat, and irrigated cultivation generally. (2) The lowland regions below 900 m. (*c*) Desert regions with small amount of rainfall (less than 250 mm.), very hot summers and cold winters. (*d*) The region of steppes and foot-hills. The summer is hot, with average temperature above 25° for the warmest month. This is a region of non-irrigated crops. (*e*) The lowland of Yalalabad with subtropical, comparatively moist climate. (3) The median zone from 900 m. to 1300 m. (*f*) Desert regions with very small amounts of rainfall and cold winters.

The soils of Afghanistan may be divided into four groups: (1) Heavy loams peculiar to swampy river valleys, chiefly in rice-growing regions; (2) medium loams of the slopes; (3) loess-like loams of the foot-hills; (4) the 'irrigation' soils of the oases.

A characteristic feature of Afghanistan is the co-existence of extremely primitive forms of husbandry with rather intensive forms of farming in the oases, which may be observed in the valley of Hari-Rud, especially near Herat. Agriculture of the valley is characterised by extraordinary diversity of crops. The methods of irrigation are thoroughly worked out cereals are harvested twice a year, and manuring i extensively practised.

The most isolated and unexplored region of Afghanistan is Kafiristan. High up in the thickets of mountain forests, the population practises a sedentary type of agriculture. Fearing the hostility of neighbours the agricultural population of Kafiristan lives on inaccessible heights. Mills are found everywhere; the plough—where possible. In places some excellently cultivated terraces of crops may be observed. Every foot of soil is utilised.

The study of Afghanistan by the expedition has established the dependence of water sources on meteorological conditions. This is naturally unfavourable to agriculture, which is adapted to the rainfall; thus the increase of acreage under winter crops depends on the rainfall in autumn.

Three principal types of irrigation were observed: (1) Source irrigation, (2) kiarese irrigation, and (3) river irrigation. The acreage of irrigated lands in Afghanistan is estimated by the authors as approximately half a million hectares, that of cultivated lands as one and a half million hectares, and the area of 'bohara' as approximately 500,000 hectares. The most wide-spread method of irrigation is with running water. Three peculiarities are noted in the native methods of irrigation: the primitive construction of the main water-carrying canals, and the good condition of small irrigation networks, and the elaborate implements used in preparing fields for irrigation.

The first place in cultivation in Afghanistan is taken by wheat, the second by barley, the third by rice. Then follow the Leguminosæ, and the next place is occupied by cotton. A considerable acreage is under alfalfa and *Trifolium resupinatum*.

The Hindu Kush dividing Afghanistan determines the general progress of agriculture from the low periphery to the main mountain range, and distinctly shows the regularities in the vertical distribution of the crops over the mountain zones. The authors give a table of the extreme elevation reached by different plants of Afghanistan under conditions of cultivation: hull-less barley, 3400 m.-3000 m.; 2500 m.-3000 m., hulled barley, peas, spring rye, *Ervum Ervilia*. This is, on the whole, the zone of spring cereals and of grain Leguminosæ. At 1500 m.-2000 m., the majority of cultivated plants appear. This is the zone of maximum diversity of crops and varieties. Grapes may be regarded as the determining plant of the zone. 1000 m.-1500 m. is the principal zone of cotton, rice,

[1] Supplement 33rd to the Bulletin of Applied Botany, of Genetics, and Plant-Breeding. Agricultural Afghanistan. (Composed on the Basis of the Data and Materials of the Expedition of the Institute of Applied Botany to Afghanistan.) By Prof. N. I. Vavilov and D. D. Bukinich. Pp. iii+610+xxxii+28 plates. (Leningrad.) In Russian, with summary in English.

ucurbitaceæ. Below 1000 m. subtropical crops rive: sugar-cane, oranges, the date palm.

The study of the separate crops is discussed in great tail in eight special chapters. The investigation varietal diversity of cultivated plants has shown at Afghanistan and adjacent countries, especially e North-Western Provinces of India, is one of the ost important primary world agricultural centres, here the varieties of numerous plants have originated. his is objectively proved by varietal diversity of a ries of crop plants and by the coincidence of the ea of the varietal diversity of many most important uropean crops. For example, as regards the versity of club wheats and soft wheats generally, ghanistan occupies the first place in the world. hough the varietal diversity of cultivated barley is or, *Hordeum spontaneum* grows abundantly in rthern Afghanistan, while eastern Afghanistan, and e adjacent regions of north-western India, are the rld centre where the maximum of characteristics of e most important Leguminosæ are found. The region probably the centre of origin of these crops. Many demic forms have been found. In regard to flax, ghanistan undoubtedly borders on one of the incipal centres where the forms of this crop have iginated. Hemp in south-eastern Afghanistan re-esents the pro-genital type of *Cannabis indica* Lam. series of oleiferous Cruciferæ have evidently inde-ndently become cultivated field crops of Afghanistan d adjacent countries. Northern Afghanistan is the alm of wild melon, with all transitions to the culti-ted type, and there is no doubt that Afghanistan is art of the primary area in which cultivated melon s originated. The extraordinary wealth of varieties carrots, turnips, and radishes show that Afghanistan the primary world centre of these crops. The same ay be observed with regard to other less important ps, such as spinach.

The botanico-geographical facts definitely direct tention to the south-eastern part of Afghanistan d regions towards the Punjab. It is in this region at the complex of genes of many European-Asiatic ps have been found. Here, and in the adjacent tricts, a series of crops have originated, a fact oved by the presence of all stages of evolution. e above-mentioned region includes the Punjab. is to this small part of India that we turn for the ution of the genesis of the above cultivated plants d not to the rest of India, which has no bearing on e majority of these crops. In regard to climate, ief, and crops, the North-Western Provinces form e undivided whole with Afghanistan. The re-ining part of India differs sharply from Afghanistan climate and soil.

At the end of the book the authors give a detailed scription of the route travelled by the expedition, th the indication of distances, the character of ndscape, short agronomical notes on the region, the scription of the road, and altitudinal data. Good ps are given illustrating geographical, orographical, logical, vegetational, and agricultural divisions of ghanistan. Most of the photographs in the book very interesting, but poorly reproduced.

University and Educational Intelligence.

LONDON.—Sir Gregory Foster has been elected e-chancellor for the year 1929–30.

The following doctorates have been conferred:—*Sc. in Biochemistry:* Mr. H. J. Channon, an internal dent of University College, for a thesis entitled The Unsaponifiable Fraction of Liver Oils"; *D.Sc. Statistics:* Miss E. M. Newbold, an internal student of University College, for a thesis entitled "Practical Applications of the Statistics of Repeated Events, particularly to Industrial Accidents"; *D.Sc. in Anthropology:* Mr. W. J. Perry, University reader in cultural anthropology, for a thesis entitled "The Children of the Sun".

A SHORT account is given in *La Nature* for June 1 of the inauguration and development during the past hundred years of the well-known École Centrale des Arts et Manufactures of Paris, the principal technical institution in France for training students for private industrial works. Founded by the four savants, Théodore Olivier, a mathematician, Eugène Péclet, a physicist, Phillippe Benoit, a mechanician, and the famous chemist J. B. Dumas, with whom was associated an administrator, Alphonse Lavallée, the school was authorised by the Minister of Public Instruction on Dec. 23, 1828, and its first session opened on Nov. 20, 1829, with 145 students. Its early career was threatened at first by the political upheaval of 1830 and then by the cholera epidemic of 1832, but it gradually grew in importance and in 1862 became a recognised government establishment. Housed at first in the old Hôtel de Juigné, it now occupies a fine block of buildings in the quadrilateral formed by the streets named after Condé, Montgolfier, Berthoud, and Vaucanson, just behind the Conservatoire National des Arts et Métiers. When Lavallée retired from the directorship, the well-known French engineer August Perdonnet succeeded him, while to-day the destinies of the school are controlled by M. Léon Guillet. During the War, between four and five thousand old students of the School served as officers in the French army, while the handsome memorial gateway at the School is to the memory of some five hundred of them who fell on the field of battle.

A FURTHER stage in the development of one of the oldest technical colleges in Great Britain was marked by appropriate ceremony on June 13, when the recently completed extension of the Wigan and District Mining and Technical College was opened by Viscount Chelmsford. The College dates back to 1857, when it began as the Wigan Mining and Mechanical School, which occupied a single room in the Mechanics' Institute and boasted 50 students. It was in 1903 that the present College buildings were opened, and in 1919 a temporary annexe was erected: this was in use until 1921, when the allocation of £32,000, together with £5000 for equipment, by the Miners' Welfare Fund, allowed the erection of the present permanent extension in its place. At the opening ceremony, the chair was taken by the chairman of the governing body, Mr. J. T. Gee, and, after Viscount Chelmsford's address, he, Mr. A. M. Lamb, vice-chairman of the governing body, and Mr. G. H. Winstanley, were presented with the honorary diploma of the College in mining. Speeches were made by Mr. J. T. Browne, president of the Lancashire and Cheshire Coal Association, Mr. J. McGurk, president of the Lancashire and Cheshire Miners' Federation, the Mayor of Wigan (Councillor P. Murphy), and Mr. P. E. Meadon, Lancashire County Director of Education. The work of the College, under Principal J. F. S. Ross, falls into four main categories: full-time courses of university or equivalent standard, full-time junior schools (technical and commercial), part-time day courses, and evening courses in a great range of subjects. The College, which stands on an island-site, has now about 110 rooms, which include nearly 30 laboratories, 9 workshops, 5 drawing offices, and many lecture- and class-rooms.

Calendar of Patent Records.

July 14, 1730.—On July 14, 1730, a patent was granted to Captain Robert Hamblin, a shipowner of Lynn, for "a new method for distinguishing of lights, whereby one light erected for the guidance of shipping may be perfectly known from another, and consequently every ship's crew be informed what coast they are off". The invention was, however, held to be an infringement of the powers of Trinity House, and the patent was revoked. Hamblin also financed the first light-ship, which was established at the Nore in 1732 by David Avery, and again brought him into conflict with Trinity House. The Admiralty agreed, however, that tolls might be levied although the ship itself should become the property of Trinity House.

July 14, 1808.—The bobbin-lace machine, the foundation of a large industry, was invented by John Heathcoat, whose first patent for the invention was sealed on July 14, 1808. The first factory was set up by Heathcoat at Loughborough, but this was attacked and the machinery destroyed by the Luddites in 1816, and the manufacture was transferred to Tiverton, where the firm is still operating.

July 15, 1846.—An early example of the 'pedrail' system of locomotion is shown in the specification of Edmund Leahy's English patent, which was enrolled on July 15, 1846. The invention is described as for the purpose of easing the motion and reducing the friction of wheels of carriages while passing over irregular surfaces, and consists in the "adaptation of a series of short rails to the wheels, which rails are linked together in a manner resembling an endless chain, arranged on rollers round the peripheries of the wheels".

July 15, 1869.—Margarine was the invention of the French chemist, Hippolyte Mège, and was patented in France on July 15, 1869, and in England the same year. The manufacture received a great impetus during the Franco-Prussian war, and was rapidly developed.

July 16, 1867.—One of the earliest systems of reinforced concrete was due to Joseph Monier, a gardener of Paris, who was the first to make extensive use of reinforced concrete and was mainly responsible for its general adoption. His French patent was granted on July 16, 1867, and the new method of construction was firmly established by the German firm of Freytag und Heidschuch, which purchased the German and Austrian rights.

July 17, 1790.—The English patent granted to Thomas Saint, a cabinetmaker of London, on July 17, 1790, contains the earliest description of a sewing machine. The machine, which is for sewing leather for boots and shoes, makes a chain-stitch, and has a perpendicular action, automatic feed for the material, and an eye-pointed needle.

July 18, 1783.—John Broadwood's piano patent, which is dated July 18, 1783, revolutionised the construction of the early square piano and represents an important step in the history of the instrument. Broadwood placed the tuning pins at the back of the case instead of as usual at the right-hand side, and added dampers and pedals. The construction was copied by all the leading makers, including those of Germany.

July 18, 1833.—On July 18, 1833, a patent was granted to Francis Maceroni for his steam-carriage, which had a multi-tubular boiler with fan-draught behind the carriage, and a horizontal two-cylinder engine below the body. A carriage was built in 1833 and ran between Edgware and Paddington for some time, attaining an average speed of 10 miles an hour. Carriages were also sent to Paris and Brussels, where they were received favourably.

Societies and Academies.

London.

Geological Society, May 29.—**K. S. Sandford**: The Pliocene and Pleistocene deposits of Wadi Qena and of the Nile Valley between Luxor and Assiut (Qau). Wadi Qena is a broad and deep dry valley which joins the Nile from the north at Qena, about 40 miles north of Luxor. The oldest beds visible within the walls of the valley system are of Pliocene age, deposited in a gulf of the Mediterranean. This had been cut by river erosion during the elevation of the Egyptian plateaux in Miocene and (in the south) partly in Oligocene times, and it was then flooded to a height of at least 550 feet above present sea-level. A non-fossiliferous series of strata was deposited in it. Great thicknesses of travertine are locally present in the series. Re-elevation carried the flooded valley system back to fluviatile conditions in Plio-Pleistocene times, accompanied by the irruption of enormous quantities of detritus from the Red Sea Hills. In Pleistocene times an ordered succession of river terraces was laid down in the Nile valley and in all the major wadis. Thereafter (in Upper Palæolithic times) desert conditions began to assert themselves, and the Nile alone survived. At about the same time the Nile carved a deep channel and re-excavated the deeper parts of the Pliocene-filled Miocene gorge. The process of filling this up still continues.

Mineralogical Society, June 11.—**E. J. Wayland** and **L. J. Spencer**: Bismutotantalite, a new mineral from Uganda. This was found in a pegmatite vein at Gamba Hill, about 35 miles north-west of Entebbe. The large rough crystals, weighing up to a kilogram or more, are orthorhombic with a habit and axial ratios similar to those of columbite. Analyses made by Mr. W. O. R. Wynn at the Imperial Institute give the formula $Bi_2O_3.Ta_2O_5$, analogous to stibiotantalite ($Sb_2O_3.Ta_2O_5$).—**L. Hawkes**: On a partially fused quartz-felspar rock and on glomero-granular texture. In a partially melted granite, fusion began at the quartz-felspar contacts. It is suggested that the temperature was raised above the eutectic point but not to the melting-point of any of the constituent minerals, and that a granite of quartz-orthoclase-albite eutectic composition will melt completely in the dry state below 950° C. Coarse-grained granites may exhibit a segregation of quartz and felspar, revealed in section by monomineralic areas of several grains in anhedral intergrowth. The name 'glomero-granular' is proposed for this texture, which may result from the normal undisturbed crystallisation of the magma.—**P. Marshall**: The occurrence of a mineral hitherto unrecognised in the phonolites of Dunedin, New Zealand. A mineral with low birefringence and low refractive index, hitherto taken to be either nepheline or sodalite, is distinct from these and nearer microsommite or davyne. It is usually allotriomorphic but also occurs as very small (0·15 mm.) hexagonal prisms. Analyses of hydrochloric acid solution of phonolites containing this mineral to the exclusion of other soluble silicates, indicate that it is a sodium aluminosilicate loosely combined with sodium chloride. The mineral stains dark violet when treated with silver nitrate. The name proposed for the mineral is ameletite.—**G. T. Prior**: The meteoric stone of Lake Brown, Western Australia. The stone, weighing when found 4·75 kgm., has been known since 1919. Chemical analysis and microscopic examination prove it to be an intermediate hypersthene-chondrite of Baroti type.—**I. de Finály** and **Sándor Koch**: Fülöppite, a new Hungarian mineral of the plagionite-

emseyite group. This was found at Nagybánya, Hungary [=Baia Mare, Rumania] as small monolinic crystals of the plagionite habit. Analysis shows t to be an acid member of the group with the formula $PbS.3Sb_2S_3$. Associated with it is an acicular probably orthorhombic) lead-antimony mineral with he composition $3PbS.4Sb_2S_3$, which is compared vith the Bolivian keeleyite.

Optical Society, June 13.—**W. M. Hampton**: The eam given by dioptric apparatus. The light in the xial direction given by a lighthouse lens using a hite source can only be white if the source is greater han a certain limiting size. For such sources a simple xpression is deduced for the axial beam candle-power or revolving lenses. A graphical method is given for omputing the candle-power of smaller sources. The ffect of the dispersion of the glass of the lens on the naximum distance at which satisfactory candle-power eadings can be made is considered. A general solution is obtained for the intensity of light of any colour n any direction and at any distance when using fixed enses.

Royal Meteorological Society, June 19.—**F. J. W. Whipple**: Potential gradient and atmospheric pollution; the influence of 'summer time'. The Kew Observatory records for periods before and after 1916 ave been compared. There are normally two scillations of potential gradient in the 24 hours; the arly morning minimum and the forenoon maximum ere both advanced when 'summer time' came in, hereas the second oscillation of the day was reduced n amplitude.—**A. J. Bamford**: Vertical air-currents s measured by pilot balloons. The results of the last even years' pilot balloon observations at Colombo now that in the first half kilometre the average rate f ascent is considerably faster than the theoretical ate given by the Dines formula, while in the next alf kilometre it is appreciably less than this value. his can be reconciled with a general atmospheric novement that is, on the whole, upwards in these ayers, by accepting the idea that tropical convection ccurs in the form of large rolling whirls of at least a ilometre in diameter, the effect of such whirls being o displace balloons from the ascending side towards he descending side after they pass the level of the entre. The next part of the paper deals with cases here the simple whirl system is complicated by nonsoonal and other circulations, and the last part eals with observations up to ten kilometres.—**George later**: Studies on the Rhone glacier, 1927: the relationship between the average air-temperature and he rate of melting of the surface of the glacier. Work n Spitzbergen suggested the following formula: M = thickness (in feet) of ice melted per month 30 days) and t = average monthly temperature (° F.), $M = (t - 32)/2$. This gives 0·2 inches of ice melted per ay for each degree (F.) above zero under normal tmospheric conditions, wind and rain producing eviations from the normal. The relationship was onfirmed by observations on the Rhône Glacier in 927 over a period of twenty days. The average temeratures (July 26 to Aug. 15) used were: Maximum 0·6° F., minimum 34·5° F., noon 43·79° F., giving a aily average of 8·8° F. above 32° F. Assuming the ate of 0·2 inches of ice melted per day for each degree, he total amount melted would be 35·2 inches, which confirmed by actual measurement.

PARIS.

Academy of Sciences, June 3.—**Ch. Achard and M. nachesco**: Chloride elimination in acute diseases and s relations with the acid-base equilibrium.—**Georges Claude**: The utilisation of thermal energy. Directing attention to a suggestion published by d'Arsonval in 1881 for the utilisation of the energy of hot springs with sulphur dioxide as the working fluid.—**E. Bataillon**: The physiological condition of male and female stereomitoses in the immature eggs of Anoura.—**Achille Le Bel** was elected a free Academician in the place of the late Marshal Foch.—**André Blondel**: A new method for the laboratory study of the beams of optical apparatus.—**J. Neyman**: A method of verification of hypotheses.—**V. Fock and D. Iwanenko**: Linear quantic geometry and parallel displacement.—**N. Cioranesco**: The method of Riemann for systems of equations of the second order.—**Jacques Chokhate**: The summation of certain series of integrable functions. Application to orthogonal functions.—**Paul Lévy**: The influence of the arguments of the coefficients on the growth of integral functions.—**J. Haag**: The elastic suspension of pendulums.—**Emile Belot**: The forms and evolution of the terrestrial mass before its spheroidal condensation.—**Thadée Banachiewicz**: The correction of orbits with the aid of co-ordinates referred to the plane of the movement.—**E. Prévot**: The determination of the international zero of altitudes, taking into account the law of variation of the mean annual level of the sea.—**Alex. Véronnet**: The electronic theory of the ether and electromagnetism.—**Henri Chaumat**: An electrostatic machine giving continuous current.—**Daure**: The comparative study of the Raman spectra of some hydrogen compounds. From the comparison of the Raman spectra of more than forty compounds, all in the liquid state, it is concluded that although it is not possible to interpret the Raman spectra of all compounds by their molecular constitution, it is possible in the limited field of hydrogen compounds alone empirically to connect certain lines with particular linkages in the molecule.—**Bourguel**: A relation between the boiling point and the molecular structure of cis-trans ethylenic saturated and acetylenic acids. The boiling points of acids containing from four to nine atoms of carbon, saturated, cis and trans ethylenic and acetylenic acids are given both in tabular and graphical form. Certain regularities appear in the latter and these are summarised.—**F. Bourion and Ch. Tuttle**: The cryoscopic determination of the molecular equilibria of resorcinol in aqueous solutions of sodium chloride.—**Maurice Fallot**: The magnetisation coefficient and structure of gelatine solutions. The curve showing the coefficient of magnetisation as a function of the concentration consists of two straight lines, with a sharp angular point at 0·8 per cent of gelatine. This concentration was also found by Marinesco to correspond to a sudden change in the dielectric constant. These results confirm the view (Smith) that gelatine can exist in two molecular forms in solution.—**Maurice François**: The action of gaseous ammonia on mercuric bromide and chloride.—**Ch. Courtot and J. Pierron**: Contribution to the study of the α-ethylenic chlorides and alcohols.—**A. Mavrodin**: The action of organomagnesium derivatives on ethyl ethylcyanacetate.—**L. Berthois**: The heavy minerals of the eruptive and crystallophyllian rocks of Brittany. Detailed study of occurrence and morphology of the zircons and tourmalines. A study of these in a disintegrated rock may give useful indications as to the nature of the mother rock (granites, granulites, gneiss or mica schists).—**Marcel Casteras**: The western termination of the Massif of Arize and the structure of the secondary deposits of the neighbourhood of Saint-Girons (Ariège).—**Auguste Chevalier**: An ancestral form of the cultivated *Arachis*.—**Paul Genaud**: The exchanges of ions between yeast cells and solutions of ammonium chloride.

From the experimental data given it is concluded that the law of mass action is capable of accounting for the equilibria between a living cell and the solution in which it is placed.—**E. Blanchard** and **J. Chaussin**: The influence of a complete manure on the osmotic pressure in some agricultural plants. The special action of potash manures. The more rapid development of certain plants (oats, beetroot) under the action of manures coincides with a greater osmotic pressure in the interior medium, and the potash manures (sylvinite and potassium chloride) play a special part in this effect.—**Maurice Parat**: The active chondriome of the animal cell and the phenomena of pachynesis.—**Raymond-Hamet**: Some pharmacological properties of the alkaloid of *Banisteria Caapi*.

CAPE TOWN.

Royal Society of South Africa, Mar. 20.—**James Moir**: Colour and chemical constitution (26). (*a*) Pigments of yellow flowers, (*b*) addenda to previous parts. The first portion deals with flavone and its derivatives the yellow flower-pigments: a miscellaneous part follows dealing with (*a*) 'loading'-phenomena, (*b*) analogues of the quinoline-cyanine dyes, and some interesting little-known colour phenomena.—**Sir Thomas Muir**: Note on the Lagrangian of a special unit determinant.—**S. H. Haughton**: Notes on the Karroo Reptilia from Madagascar. Redescriptions of material in the Paris Museum. All the genera fall within the order Eosuchia, which is redefined; and two main lines of descent from *Youngina* within the order are indicated.—**K. H. Barnard**: A study of the genus *Colophon* (Coleoptera). The genus is essentially a mountain form, living on the summits of the peaks, and is flightless. Only two species were known, one of which has never been rediscovered since its description in 1855. Five new species have now been discovered.—**S. Schonland**: The South African species of *Rhus*, L. There is comparatively little diversity in the flowers of our *Rhus*. Inflorescences and fruits yield distinctive characters in many cases, but on the whole one has to rely on vegetative organs, which, however, vary often on the same plant within wide limits. The plant is usually unisexual, and male and female plants are sometimes different. Further, coppice shoots often show distinctive features. Interspecific hybridisation is not uncommon.—**F. E. Fritsch** and **Florence Rich**: Contributions to our knowledge of the freshwater Algæ of Africa. (8.) Bacillariales (Diatoms) from Griqualand West. In point of actual abundance, Diatoms form an important part of the algal flora of Griqualand West, but the actual number of species present is small. The total number here recorded is 72, of which 5 are new, while 4 new varieties are described. There are 25 new records for South Africa.

CRACOW.

Polish Academy of Science and Art, Mar. 8.—**W. Swietoslawski, Z. Blaszkowska**, and **E. Jozefowicz**: The boiling-point method of determination of the constant of chemical equilibrium.—**W. Swietoslawski** and **J. G. Zawidzki**: The application of reduced equations in chemical kinetics.—**L. Marchlewski** and **J. Meyer**: The absorption of ultra-violet rays by certain organic substances. The substances under examination included derivatives of furfurane, and isomeric bisubstituted benzene derivatives.—**J. Wasowicz**: The limits of perpetual snow in the Cordilleras of Alaska and Canada.

April 8.—**C. Fuja**: The formation and development of the stems and roots on the isolated cotyledons of *Cucurbita*, *Cucumis*, and *Lupinus*.—**S. Maziarski**: The striated ramified muscular cells in the liver of spiders.—**J. Wiszniewski**: Two new species of rotifers: *Pedalia intermedia* and *Paradicranophorus limosus*.—**M. Gieysztor**: Contributions to the knowledge of some species of Rhabdoceles belonging to the genera *Dalyellia*, *Castradella*, *Castrada*.—**S. Wisniewski**: The genus *Archigetes*: its anatomy, histogenesis, and biology.—**W. Szafer**: The flora of Poland.

May 6.—**T. Wazewski**: The change of the variable in simple integrals.—**Ladislas Natanson**: Certain properties of groups of waves.—**Nalini N. Bosc**: Fourier's series subjected to a quantic condition.—**Satyendra Ray**: (1) The regressive wave. (2) The generalisation of the virial of Clausius. If the pressure of the gas is not uniform but varies in the neighbourhood of the vessel walls according to a fixed law, the equation of the virial still holds good.—**L. Kwiecinski** and **L. Marchlewski**: The absorption of ultra-violet rays by benzene.—**L. Marchlewski** and **B. Skarzynski**: The absorption of ultra-violet light by certain hormones and by some analogous substances.—**R. Malachowski**: The constitution of anhydrotricarballylic acid.—**F. Poznanski**: The reactions of nitrous acid and of the diazo compounds on the substances contained in plants.

GENEVA.

Society of Physics and Natural History, April 18.—**Sw. and Th. Posternak**: The configuration of inactive inosite. By controlled oxidation of inosite with alkaline permanganate, the authors have obtained allomucic acid. This result, taken in conjunction with the optical properties of certain natural inositophosphoric esters previously described by the authors and by Anderson, leads to the selection for inactive inosite of that one of the seven stereochemical formulæ predicted by the theory which shows five hydroxyl groups on the same side of the plane of the ring, the sixth being found on the opposite side. The formation of ribosophosphoric acid of the nucleotides at the expense of the monophosphate of inosite, by the opening of the ring, becomes probable. This throws some light on the obscure question of the physiological rôle of inosite.

May 2.—**L. Duparc**: The geology of the lower Congo (left bank of the Niari). The author has prospected a region situated to the west of Mindouli. Two formations were found: the limestone schist at the base, supporting, sometimes discordant, red grits (Kundelungu). Two systems of orthogonal folds, east-north-east and north-north-west, were verified, the crossing of which gave rise to formation of domes.—**M. Gysin**: Some optical properties of mucic acid. The author has successfully applied Fedorow's method and the usual petrographic methods to crystals of mucic acid of very small dimensions ($60 \times 15 \times 10$ microns). He has proved a very strong double refraction $n_g - n_p = 0{\cdot}33$ and an angle for the optic axes $2V = -75°$.

May 16.—**L. Duparc, P. Wenger**, and **Ch. Cimerman**: The combination of nitrogen with manganese. The authors have studied the part played by the five following factors on the course of the reaction: the composition and origin of the manganese, temperature, duration of the reaction, pressure, catalyst. For the last two the results are new: the nitrogen fixed increases with the pressure and lithium nitride used as the catalyst increases the fixation of the nitrogen and accelerates the dissociation.—**A. Jayet**: The presence of old glacial and interglacial formations in the northern part of the Canton of Geneva. The author has found a typical base moraine covered by stratified clays. The latter in turn support a recent moraine. The old moraine has never been distinguished in visible outcrop except by excavation. Up to the present, only two moraines have been proved in the

asin of Lake Geneva.—**R. Wavre**: The second approxiation in the investigation of the free surface of the anets. The author continues the study of the form the exterior surface of stars in rotation by the ethod indicated in an earlier note. He makes a ore extended investigation in which the terms of the cond order are not neglected and gives the results very lengthy calculations, giving the Newtonian otential on the polar axis and the flattening of the uipotential surfaces.

ROME.

Royal National Academy of the Lincei, April 7.—**. Giorgi and A Cabras**: Relativistic questions on the roofs of the earth's rotation. Nordmann has recently ated that, in the light of modern physics, it is as gitimate to regard the stellar universe as rotating ily round the earth as to consider that the earth volves about its axis. The author discusses this uestion and concludes that the earth is endowed ith rotation with respect to local inertial axes. Of alileo's proofs, those of generic character deduced om considerations of symmetry in the distribution velocity throughout the whole of the stars are really alid, as well as the specific proof derived from the ll of weights from a tower. To these are to be added oucault's proof, gyroscopic proofs, Michelson and ale's experiment, and, though less directly, those epending on centrifugal force.—**Q. Majorana**: Photoectric thallium cells. Rolla and Mazza's claim to riority as regards these cells is disputed. The disovery of such cells is due to Case (1920), but an xact and detailed process for preparing them was rst published by Majorana and Todesco (1928).—**. Cambi and A. Clerici**: Reactions between ferrous ompounds and nitric oxide. The results of experients on the interaction of iron nitrosulphate and kali hydroxide indicate that the decomposition of is complex proceeds according to the schemes: >Fe . NO] $\longrightarrow$ $2[Fe'''] + N_2O$ (1) or $2Fe''' + \frac{1}{2}N_2 + NO$) or $2Fe'' + 2NO$ (3). Decomposition (1) occurs uantitatively in an alkaline medium and only as a econdary reaction in presence of acid; in neutral olution in presence of $Ag^{\cdot}$ the same reaction corresponds with the formation of silver hyponitrite. The issions (2) and (3) take place in acid media, the rmer predominating, as is shown by the fact that he ratio between the numbers of nitrogen atoms as $_2$ and as NO tends towards unity, whilst the ferrous on undergoes progressive reduction. Reactions nalogous to the above are observed in the action NO on ferrous carbonate, bicarbonate, and phosnate.—**G. Cimmino**: Extension of Picone's identity the more general ordinary linear differential uation.—**Pia Nalli**: Parallelism and geodetic coordinates.—**E. Bortolotti**: Congruence stars and solute parallelism: geometrical bases of a recent eory of Einstein.—**G. Mammana**: Decomposition of omogeneous linear differential expressions into symlic factors of the first order.—**M. Picone**: Addition the note: Demonstration of a theorem of analysis ed in plane physics.—**L. Toscano**: Dual formulæ Newton.—**L. Onofri**: Series of powers which assume e circumference of convergence as a singular line.—**Natta and L. Passerini**: Spinels of the type $e_2''Me^{IV}O_4$. Results are given of the examination means of X-rays and by the powder method of agnesium and cobaltous orthostannates, Mg_2SnO_4, d Co_2SnO_4, prepared by calcining the products tained by precipitating with alkali hydroxides lutions containing one molecule of stannic chloride d two molecules of magnesium or cobaltous chloride. baltous orthostannate crystallises in the cubic stem, and the unit cell, containing eight molecules, has the side $8{\cdot}605 \pm 0{\cdot}005$ A. and the volume $637{\cdot}16 \times 10^{-24}$ c.c.; the röntgenographic density is 6·307, the experimental value being 6·108. The magnesium salt is isomorphous with the cobaltous compound, the cell having the side $8{\cdot}580 \pm 0{\cdot}007$ A., and the volume being $631{\cdot}63 \times 10^{-24}$ c.c.; the röntgenographic density is 4·864, and the experimental density 4·738. Calculation of the structure factor shows that the space structure of these compounds belongs to the type 8*f*, 16*c*, 32*b* (space group O_h^7) and corresponds with that of the spinels. For the parameter *u* defining the position of the oxygen a value approximating to 1/8 is found.—**V. Caglioti**: Polyhalides (1). Chloroiodic acid, $HICl_4$, $4H_2O$. This acid may be obtained by adding finely divided iodine to concentrated hydrochloric acid and passing chlorine through the liquid until the iodine dissolves completely. The deep orange-red solution thus formed is converted almost entirely into crystals of chloro-iodic acid when immersed in ice.—**G. Malquori**: The systems $Al(NO_3)_3 - Fe(NO_3)_3 - H_2O$ and $KNO_3 - Fe(NO_3)_3 - H_2O$ at 0° and 40°. Neither at 0° nor at 40° does nonahydrated ferric nitrate form additive compounds or mixed crystals with either potassium nitrate or nonahydrated aluminium nitrate.—**A. Occhialini**: Length of the lines in the spectrum of a spark in relation to the concentration of the element. Experiments on various nickel and lead-tin alloys show that observation of the length of the spectral lines of the spark furnishes a rapid means for the quantitative analysis of alloys.

Official Publications Received.

BRITISH.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1928. Pp. 32+2 plates. (Jamaica: Government Printing Office, Port-of-Spain.)

Colony and Protectorate of Kenya: The British East African Meteorological Service. Memoirs, 1: Note on the Inauguration of a Joint Meteorological Service for British East African Territories. Under the Direction of A. Walter. Pp. 5. (Nairobi: Government Printer.)

Imperial Agricultural Research Conference, 1927. Abstracts of Papers on Agricultural Research in the United Kingdom, published during the Year October 1927 to September 1928. Pp. 115. (London: Ministry of Agriculture and Fisheries.) 1*s.* net.

Southern Rhodesia. Geological Survey Bulletin, No. 12: The Geology of the Shabani Mineral Belt, Belingwe District. By F. E. Keep. Pp. v+193+18 plates. (Salisbury, S.R.)

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Gardens, Whitehill, near Matjesfontein), for the Year ending 31st December 1928. Pp. 29. (Kirstenbosch.)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1928. Pp. 10. (Cape of Good Hope.)

The Quarterly Journal of the Geological Society. Vol. 85, Part 2, No. 338, June 20th. Pp. xlix-cxxviii+109-222. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

Scientific and Industrial Research Council of Alberta. Report No. 18: The Bituminous Sands of Alberta. By K. A. Clark. Part 3: Utilization. Pp. vi+33. (Edmonton, Alba.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1929. Pp. xii+58. (Aberdeen.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv+99. (London: H.M. Stationery Office.) 2*s.* net.

Mines Department. Report on an Investigation at the Mines Department Testing Station, Sheffield, of the Safety of Miners' Electric Cap Lamps when the Battery is Short-circuited. By Capt. C. B. Platt and G. A. Cutler. Pp. 7. (London: H.M. Stationery Office.) 2*d.* net.

Proceedings of the Royal Society. Series A, Vol. 124, No. A795, July 1. Pp. 477-723+x. (London: Harrison and Sons, Ltd.) 8*s.*

City of Norwich. The Report of the Castle Museum Committee to the Council, 1928. Pp. 30. (Norwich.)

The Research Scheme of the Institute of Brewing. Memorandum, 1929. Pp. 20. (London.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1927. Pp. 147. (London: H.M. Stationery Office.) 5*s.* net.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 15. Pp. 223-289. (Trinidad: Government Printing Office, Port-of-Spain.)

FOREIGN.

Comptes rendus de la quatrième séance de la Commission Géodésique Baltique, réunie à Berlin du 24 au 28 Septembre 1928. Redigés par le Secrétaire-général Ilmari Bonsdorff. Pp. iii+164. (Helsinki.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81. New Light on the Collection of North American Plants by Peter Kahn. By H. O. Juel and John W. Harshberger. Pp. 297-303. Agalinis and Allies in North America, II. By Francis W. Pennell. Pp. 111-249. Pseudohyaline American Land Snails. By H. Burrington Baker. Pp. 251-266. Leeches from Borneo with Descriptions of New Species. By J. Percy Moore. Pp. 267-295. (Philadelphia.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 23, Part 3: Arbeiten aus dem Institut für Gerberei-Wissenschaft, Mitteilung 4. Von Prof. Dr. G. Grasser und Dr. H. Nakanishi. Pp. 87-125. (Tokyo: Maruzen Co., Ltd.)

University of Illinois Engineering Experiment Station. Bulletin No. 191: Rolling Tests of Plates. By Prof. Wilbur M. Wilson. Pp. 60. (Urbana, Ill.) 30 cents.

University of California Publications in American Archaeology and Ethnology. Vol. 26: Aboriginal Society in Southern California. By William Duncan Strong. Pp. x+358. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 4.50 dollars.

Methods and Problems of Medical Education. (Twelfth Series.) Pp. v+466. (New York: The Rockefeller Foundation.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 57: Scientific Report of the North-Western Area Committee for 1926–27 (Rapport Atlantique, Secteur Nord-ouest, 1926–27.) By Prof. Johs. Schmidt. Pp. 73+28+11+134. (Copenhague: Andr. Fred. Høst et fils.) 10.00 kr.

Ministry of Finance. Calendar for the Year 1929. Pp. vii+373. (Cairo: Government Press.) 5 P.T.

Bulletin of the National Research Council. No. 68: Transactions of the American Geophysical Union, Ninth Annual Meeting, April 26 and 27, 1928, Washington, D.C. Pp. 103. (Washington, D.C.: National Academy of Sciences.)

Smithsonian Institution: United States National Museum. Bulletin 146: Life Histories of North American Shore Birds, Order Limicolae (Part 2). By Arthur Cleveland Bent. Pp. ix+412+66 plates. (Washington, D.C.: Government Printing Office.) 1 dollar.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 2, No. 5. R.P. No. 60: Continuous Spectrum X rays from Thin Targets, by Warren W. Nicholas; R.P. No. 61: A Multiple-Strand Test for Yarns, by Charles W. Schoffstall and H. A. Hamm; R.P. No. 62: Thermal Expansion of Tantalum, by Peter Hidnert; R.P. No. 63: Sound proofing of Airplane Cabins, by W. L. Chrisler and W. F. Snyder; R.P. No. 64: Prism Refractometry and certain Goniometrical Requirements for Precision, by L. W. Tilton; R.P. No. 65: A new Determination of the Melting Point of Palladium, by C. O. Fairchild, W. H. Hoover and M. F. Peters; R.P. No. 66: A new Seismometer equipped for Electromagnetic Damping and Electromagnetic and Optical Magnification (Theory, General Design and Preliminary Results), by Frank Wenner. Pp. 837-999. (Washington, D.C.: Government Printing Office.)

World Weather Records. Errata collected by Dr. Felix Exner, Dr. G. C. Simpson, Sir Gilbert Walker, H. Helm Clayton, Robert G. Mossman. Assembled and arranged for Publication by H. Helm Clayton. (Publication 3019.) To accompany Smithsonian Miscellaneous Collections, Vol. 79 (whole volume). Pp. iii+28. (Washington, D.C.: Smithsonian Institution.)

Classified List of Smithsonian Publications available for Distribution, May 20, 1929. Compiled by Helen Munroe. (Publication 3020.) Pp. iv+29. (Washington, D.C.: Smithsonian Institution.)

Memorie del R. Ufficio Centrale di Meteorologia e Geofisica, Roma. Serie 3, Vol. 2: Misure magnetiche in Oltregiuba e Somalia nel 1926. Memoria di L. Pallazzo. Pp. 63+4 tav. (Roma.)

Havsforskningsinstitutets Skrift. No. 49: Die thalassologische Terminfahrt im Jahre 1927. Von S. E. Stenij. Pp. 20. 20 Fmk. No. 50: Översikt av Isarna Vintern 1916–17. Referat: Übersicht der Eisverhältnisse im Winter 1916–17 an den Küsten Finnlands. Av E. Palmén. Pp. 43. 20 Fmk. No. 51: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1926. Herausgegeben von Gunnar Granquist. Pp. 44. 25 Fmk. No. 52: Päivittäisiä Vedenkorkeusarvoja 1925, dagliga Vattenståndsuppgifter 1925. Referat: Tägliche Wasserstandsangaben 1925. Av Henrik Renquist. Pp. 44. 20 Fmk. No. 53: Die p_H-Bestimmung des Meerwassers; Studien über Eigenschaften und Gebrauch einiger hierfür geeigneten Farbenindikatoren. Von Kurt Buch. Pp. 30. 25 Fmk. No. 54: Havsforskningsinstitutets värksamhet under år 1927. Av Rolf Witting. Pp. 18. 10 Fmk. No. 55: Översikt av Isarna Vintern 1926–27. Referat: Übersicht der Eisverhältnisse im Winter 1926–27 an den Küsten Finnlands. Av Gunnar Granquist. Pp. 52. 20 Fmk. No. 56: Översikt av Isarna Vintern 1927–28. Referat: Übersicht der Eisverhältnisse im Winter 1927–28 an den Küsten Finnlands. Av Gunnar Granquist. Pp. 56. 20 Fmk. No. 57: Översikt av Isarna Vintern 1918–19. Referat: Übersicht der Eisverhältnisse im Winter 1918–19 an den Küsten Finnlands. Av E. Palmén. Pp. 35. 15 Fmk. No. 59: Beobachtungen von Strom und Wind an den Leuchtschiffen in den Jahren 1926 und 1927. Von E. Palmén. Pp. 22. 20 Fmk. No. 60: Beobachtungen im Ladoga-See in den Jahren 1898–1903. Herausgegeben von Rolf Witting. Pp. 34. 25 Fmk. (Helsinki.)

The Peking Society of Natural History. Bulletin, Vol. 3, Part 3: A Canton Sponge, by N. Gist Gee; Chinese Crickets, by Y. C. Hsü; Peking Diatoms, by B. W. Skvortzow. Pp. 48+3 plates. (Peking.) 1 dollar.

Smithsonian Miscellaneous Collections. Vol. 81, No. 13: Descriptions of Four New Forms of Birds from Hispaniola. By Alexander Wetmore. (Publication 3021.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the United States National Museum. Vol. 75, Art. 9: Recent Foraminifera from off Juan Fernandez Islands. By Joseph A. Cushman and R. T. D. Wickenden. (No. 2780.) Pp. 16+6 plates. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Special Bulletin No. 187: What makes some Farms Pay; a Business Analysis of 114 Farms in Eaton County, Michigan. By E. B. Hill and F. T. Riddell. Pp. 26. Special Bulletin No. 191: Barley for Michigan Farms. By H. C. Rather, E. E. Down, H. M. Brown and F. H. Clark. Pp. 28. Technical Bulletin No. 97: Studies on the Overwintering and Modes of Infection of the Fire Blight Organism. By E. C. Tullis. Pp. 32. (East Lansing, Mich.)

Det Kgl. Danske Videnskabernes Selskab: Mathematisk-fysiske Meddelelser. Bind 8, No. 10: On the Lichtenberg Figures. Part 3: The Positive Figures. By Prof. P. O. Pedersen. Pp. 137+28 plates. 10.00 kr. Bind 9, No. 5: Wireless Echoes of Long Delay. By Prof. P. O. Pedersen. Pp. 48. 2.40 kr. (København: Andr. Fred. Høst and Son.)

Department of Commerce: Bureau of Standards. Miscellaneous Publication, No. 92: Code for Protection against Lightning. Approved April 4, 1929, by the American Standards Association. Pp. xiii+114+2 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 18, Article 2: Fall and Winter Stoneflies, or Plecoptera, of Illinois. By Theodore H. Frison. Pp. 341-409. (Urbana, Ill.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský sous le patronage de la Regia Societas Scientiarum Bohemica. Année 1, No. 6, Juin. Pp. 315-367. (Prague.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen, 31: Über die Ausbreitung des Schalles bei der Versuchssprengung in Oldebroek am 28 Oktober 1922. Von Dr. E. van Everdingen. Pp. 69+3 Tafeln. 1.10 fl. No. 104a, Supplement. Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan, Maart, April, Mei (1856–1912). Tabellen. Waarnemingen Noord van 0° (1856–1923). Pp. iii+36. 1.25 fl. (Amsterdam: Seyffardt's Boekhandel.)

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning år 1928. Pp. 43. (Göteborg: Elanders Boktryckeri A.-B.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 190: On Tea Catechin isolated from Green Tea. By Michiyo Tsujimura. Pp. 253-261+plates 26-27. 30 sen. No. 191: Sur la lampe à cadmium de type nouveau. Par Hantaro Nagaoka et Yoshikatsu Sugiura. Pp. 263-270. 20 sen. Supplement, No. 10: The Radioactive Constituents of Hokutolites and other Minerals in Japan. By Jun Yoshimura. Pp. 47-52. 10 sen. (Tōkyō: Iwanami Shoten.)

United States Department of Agriculture. Technical Bulletin No. 90: Life History of the Codling Moth in Northern Georgia. By E. R. Van Leeuwen. Pp. 95. (Washington, D.C.: Government Printing Office.) 20 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 82: Bee-Keeping in Palestine and Egypt Compared, June 1927. By J. E. M. Mellor. Pp. ii+17+13 plates. 5 P.T. Bulletin No. 88: Note sur la peste bovine en Égypte. Par Dr. Ibrahim Fahmi Salem. Pp. 56. 5 P.T. (Cairo: Government Press.)

CATALOGUE.

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (July.) Pp. 130. (London: The British Drug Houses, Ltd.)

Diary of Societies.

MONDAY, JULY 15.

EGYPT EXPLORATION SOCIETY (at Royal Society), at 5.—Dr. H. Frankfort: The Winter's Work of the Society (Lecture).

TUESDAY, JULY 16.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section).—Visit to the Works of Messrs. J. S. Fry and Sons, Ltd., at Somerdale, near Bristol.

WEDNESDAY, JULY 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section), at 2.30.—Visit to Seghill Colliery.

PUBLIC LECTURE.

TUESDAY, JULY 16.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Sir Thomas Lewis: Observations Relating to the Mechanism of Raynaud's Disease (Victor Horsley Memorial Lecture).

CONFERENCES.

JULY 12 TO 14.

MIND ASSOCIATION (Annual Meeting) (jointly with Aristotelian Society) (at University College, Nottingham).

Friday, July 12, at 8 P.M.—Prof. F. Granger: Probability and Paradox.

Saturday, July 13, at 10 A.M.—Prof. G. E. Moore and H. W. B. Joseph: Indirect Knowledge.

At 2.—Prof. J. Laird, C. E. M. Joad, and Miss L. S. Stebbing: The Present Position of Realism.

At 8 P.M.—J. D. Mabbott, H. H. Price, and G. Ryle: Negation.

Sunday, July 14, at 2.—Prof. G. Dawes Hicks, Prof. B. Edgell, and Prof. G. C. Field: Immediate Experience.

At 8 P.M.—Address.

JULY 13 TO 20.

ROYAL SANITARY INSTITUTE (at Sheffield).

In Sections devoted to Preventive Medicine, Architecture and Engineering, Maternity and Child Welfare (including School Hygiene), Hygiene of Food, Hygiene in Industry, Veterinary Hygiene, Representatives of Sanitary Authorities, National Health Insurance Services, Medical Officers of Health, Engineers and Surveyors, Sanitary Inspectors, Health Visitors (including Personal and Domestic Hygiene).

JULY 23 TO 26.

BRITISH MEDICAL ASSOCIATION (at Manchester).

Public Library

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The Future of Agriculture.

A REMARKABLE suggestion has lately appeared in certain well-informed quarters of the American press, namely, that there are far too many farmers, that there is even now considerable over-production of farm produce, with still greater potential risk of such over-production, and that the only real remedy, drastic as it may appear, is the return of millions of farmers and their families to city life and work—if it can be found. It is estimated that there are about 6,500,000 farmers now engaged on American soil, but only a mere fraction of these are really efficient, up-to-date, prosperous, and contented; and the vast majority, more than five millions of them, have a desperate struggle to make a living. A vigorous agricultural deflation programme is seriously recommended.

It is very doubtful if such a proposal, though backed by many plausible and at first sight very convincing arguments, will prove very acceptable either to the farmers themselves or to the general American public. The latter, from President Hoover downwards, has for at least twenty-five years past constantly and consistently called for a vigorous and far-reaching policy of 'back to the land'. It has, of course, always been firmly held by a certain and predominating type of mind, especially of the physiocratic sort, that a numerous and, if possible, prosperous peasantry or yeomanry is a basic factor in national strength and balance; and if, as is generally assumed, it be the only or the most important source of the stronger and more vigorous elements in national life, there is much to be said in its favour. However, the most favourable ratio between town and country, between the agricultural and industrial parts of the population, is a highly complex problem and cannot be fully discussed here; although one may pertinently inquire if England, for example, is weaker because nine-tenths of its population is urban.

In America it has scarcely been seriously questioned that a large farming community is a necessary condition of strength. 'Back to the farm' has been a national cry, despite the terrible crisis of 1920–21. The farmers have been looked upon as constituting one of the largest and most valuable parts of the home market: a view which has also been consistently held in Great Britain, not without a tinge of envy at America's supposed very favourable position in this respect.

This complacent state of mind has now suffered a severe shock. Of the 6,500,000 farmers in the United States, it is alleged that only about one-

eighth, or say 800,000, have taken full advantage of the most advanced scientific methods and use of machinery. The others, constituting the vast majority, are, it is stated, hopelessly inefficient and on the brink of destitution and ruin. If this be true, it is a really remarkable state of affairs in view of the present position of agricultural education, both in theory and practice, in the U.S.A. After so many years of continuous and high pressure endeavour on the part of nearly every responsible person in America—statesmen, economists, social reformers, educationists, the all-powerful ubiquitous press—to foster and perfect agricultural education and bring the benefits of the latest research to the most remote corner of the country, is it possible, one may well inquire, that five million American farmers remain inefficient and unprosperous? Further, what have the makers of farm machinery, of concentrated fertilisers, of improved, selected seeds, and other farm requirements, been doing all this time?

The worst of the tale is, however, not yet unfolded. Over-production with low price level is held to be the root cause of the American farmer's plight to-day, and notwithstanding the voluminous flood of legislation, aiming at his assistance and relief, starting with the Fordney Emergency Tariff Bill and finishing up with the luckless and oft-defeated McNary-Haugen Bill, and the more recent and ambitious Farm Board proposal, there is little hope of real remedy except in a drastic reduction in the number of farmers. At least that is the view which appears to be gaining ground in some quarters. Then, if this be so, not only are we to believe that the great majority of American farmers are backward and inefficient, but also that it is, in a sense, fortunate that they are so! If all of them became as up-to-date as the small minority, then production and output would reach such vast proportions, and prices would fall to such extremely low levels, that the plight of the farmers would be far worse than it is now.

A pretty dilemma, to be sure, and a very curious paradox; not exactly gratifying to the protagonists of agricultural research and of improved methods, or to the sellers of machinery and fertilisers. It forms a strange commentary also on Sir Daniel Hall's presidential address on food and population to Section M (Agriculture) of the British Association in 1926. As a specific illustration the case of wheat has been taken. The present production of wheat in the U.S.A. is about 800,000,000 bushels per annum, which means a low average yield of no more than 13 bushels to the acre (as compared with about 32 in England and 41 in Denmark). Of this amount, about 200,000,000 bushels is exported. It is assumed, perhaps a little rashly, that under improved methods the yield per acre could be doubled. Modern science can doubtless do much, but still the law of diminishing returns is even so not yet quite obsolete and still operates though sometimes very much in the background; and it does appear a rather hazardous assumption to suppose that the yield of American wheat per acre could be doubled and at a lower or equal unit cost. But without quibbling about the precise increase possible under better methods, even a 50 per cent increase would be disastrous, since there is already over-production with present yields.

The further assumption is made that no great extension of demand is possible either in the home market or in the export trade. The American citizen is not likely to be able or willing to eat more, and in fact the modern tendency under the latest nutrition and hygienic teaching is to eat less, so that the branches of agriculture devoted to the production of human food cannot look for much increase in demand in the home market. As for the export trade in food, this is already declining in the direction of Europe, and despite recurring famines and a more or less chronic state of malnutrition near approaching starvation in many parts of India and China, these poverty-stricken parts of the world cannot afford a larger share of American agricultural abundance at prices satisfactory to the American farmer. In regard to the production of raw material, such as cotton, it is likewise assumed there is little prospect of substantial increase in demand.

It is therefore concluded that the only true remedy is a large reduction in the number of farmers. Whether this means that the farms so abandoned are to go out of cultivation or are to be absorbed by the minority of efficient and prosperous farmers is not quite clear; but apparently the great bulk of the land would have to go out of cultivation, since, if worked by the successful farmers, output and over-production would be on so vast a scale as to be unthinkable. It might be possible, perhaps for a few of the inefficient farms say up to 100,000, to join the present 800,000 but no more. Hence the only possible solution appears to be the removal of about 5,000,000 farmers from their present homesteads to the cities, that is to say, an exodus from farm to city of approximately 14,000,000 persons.

It looks as if such a drastic 'remedy' would involve greater problems and difficulties than those

ready existing. It is pointed out, however, that ie absorption by manufacturing industry in the ties of such a vast number would not be more fficult, if spread over a period of ten or more years, an the like absorption of about one million im-igrants from Europe every year before the quota olicy was introduced. Also, there is already in vidence a certain migration of population from ie country and farm life to the towns, especially nce the disastrous farming years 1920 and 1921. is estimated that, since those years, about four illion persons have returned to the cities ; and immigration could be still more rigorously re-ricted, this transfer could be greatly accelerated.

The position of American agriculture, as above escribed, contrasts strongly with the interesting iesis discussed by Sir Daniel Hall in his presidential ddress to which reference has already been made. n that address he presented data showing that the verage consumption of food and raw material by hite peoples requires from 2 to 2½ acres per head ; lso that the white population of the world is in-reasing at the rate of about five million per annum, nvolving a commensurate increase in cultivated nd of 12½ million acres per annum, or alternatively proportionate increase in yields on the existing rea, since there are no new areas worth speaking to be opened up. The only way to meet the nhanced demand for farm produce is by means of ore intensive culture, more scientific methods, nd in particular the much more considerable use synthetic fertiliser.

This, of course, may still remain true as the ex-ression of a general tendency for the greater part the world which is bound to operate in the long n ; but if the American position is really that hich has just been described—namely, over-roduction even though the great majority of the rmers are producing at a very low level—then it ould seem that the general rule enunciated by r Daniel Hall appears to be subject to substantial cal or temporary checks ; although, on the other and, it is quite possible that the American position as not been quite correctly diagnosed, and certainly me rather large assumptions have been made. ne may yet conclude that the bounty of Nature nd science is far greater than we have ever en-saged in our wildest dreams, that the law of minishing returns may be suspended almost definitely, and that there is—and will be for me time—an economic limit to the extent to hich the world, as a whole, can employ the mighty owers and resources of modern science in the alm of agriculture.

A Philosophy of Biology.

Theoretische Biologie. Von J. von Uexküll. Zweite gänzlich neu bearbeitete Auflage. Pp. x+253. (Berlin : Julius Springer, 1928.) 15 gold marks.

THIS is a really great book, well worthy of close study not only by biologists but also by all scientific men. For is not biology the science of life, and the first and most fundamental question raised by that science is " What is life ? " The author endeavours to look this question, and the other far-reaching questions which arise out of it, fairly in the face, and it is then seen that not only is biological science in the narrower sense involved, but also all other science of every description. Life is primarily our own existence, and secondarily the nature of other ' things ' in which we suspect an existence in some respects at least similar to our own. The first problem presented, therefore, to biology is the analysis of our own existence.

All science, physics and chemistry no less than biology, consists in the study of ' phenomena ', that is, of ' appearances ' to our conscious minds, and the question to be settled is how much of the ' appearance ' is due to the structure and working of the mind itself, and how much to an event independent of the mind. In endeavouring to answer this question, Uexküll affirms, and in our judgment quite justly, the soundness of the position taken up by Kant in the " Critique of Pure Reason ". He endeavours to extend Kant's theses. Kant asserted that space and time, which enclose within them all phenomena, are ' forms ' which our mind imposes on phenomena, and Uexküll not only reasserts this, but also adds to it that colour tone and odour are equally mental constructs, as are concepts of motion, including wave motion, and what the ' thing-in-itself ' would be like when stripped of these mental accretions no human being can conceive. He scourges with just contempt the assertions of mechanistic biologists that mind is a name for the physical and chemical actions of matter, since all the qualities which make matter anything else than ' pure being ' are conferred on it by mind.

Space is a general synopsis of our earliest fundamental experiences. Vision alone will not give us space, for the field of vision is spread out before the baby like a flat picture ; it is only gained when to this experience are added the efforts of the eye-muscles and of the arms in reaching after objects. This space which thus summarises our muscular experience is always three-dimensional Euclidean space,

and this is the only kind of space for which there is justification: all other so-called kinds of space are merely mathematical juggling with symbols.

Time, again, reflects the nature of our experience, which always consists of phases succeeding one another, and is irreversible; any other conception of time is merely a mathematical fiction.

Colour experience forms a scale of values beginning with deep red and passing through yellow, green, blue, and violet to something suspiciously like deep red again. Tone likewise exhibits a series of values in octaves; taste includes only four fundamentals. Sensations of odour, too, when properly investigated, will likewise reveal a similar scale of values. We live in a human world largely built up by our minds, and we can no more escape from it than we can lift ourselves up by our own waistbands.

In studying other living beings, therefore, and especially animals, we must always bear this limitation in mind. It is wrong, Uexküll asserts, to say there is one sun; there is a human sun, a lion's sun, and a fly's sun, as well as many others—and there is no certainty in correlating these with each other. But our earliest essays in comparative biology are completed when we are children: we then learn to distinguish some of the 'appearances' as our own body, from the outside world, because from the body we get a double set of stimuli—we can not only see it and feel it, but also sensations of pain arise in it when it is too roughly handled. When the crural nerves of a rat are severed it will devour its own toes—they are for it edible material and part of the outside world. Secondly, we learn to recognise amongst other 'appearances' some that are the envelopes of similar minds to our own. This is the really great advance in biology; all other subsequent advances are small in comparison to it. Zoology is merely the extension of this discovery so as to recognise behind another set of 'appearances' a series of minds in some respects resembling our own but much simpler, and in fact forming a graded series in degrees of simplicity.

Since our minds are awakened by stimuli received through the sense organs and express themselves in actions carried out by our muscles, we can hazard some kind of guess as to what the minds of animals must be like, in so far as we note a similarity between their sense organs and ours and a similarity between their effectors (muscles) and ours. As Uexküll expresses it: "Every animal is a subject which, thanks to its peculiar structure, selects from the general action of the outer world certain particular stimuli to which it responds. These responses consist in reciprocal actions on the outer world and these actions alter the stimuli: thus arises a circle which may be called the functional circle of the animal. The sum of the stimuli which act on the animal constitute a world; the stimuli shape themselves into objects (*Merkdinge*) which cause the animal to direct its motions, just as objects perceived at sea make the helmsman port his helm. The objects taken together may be termed the 'world of perception'. The conscious directive actions exercised by the animal on its movements form its 'inner world'. The movements themselves form a 'world of action'. The 'world of action' and the 'world of perception' taken together constitute the environment."

It is, of course, the aim of physiology to compare animals to machines and thus to explain as much of their actions as possible. This doctrine is heavily attacked by Uexküll. He points out that in every conceivable machine there are two elements, namely, the material out of which it is made and the framework of fixed parts by the reciprocal movements of which its movements are effected. So long as the framework is relatively rigid, the material out of which it is constructed is unimportant. But in the living organism there is no distinction between framework and material the two pass uninterruptedly into one another the living substance constructs the framework and can dissolve it. This is most strikingly shown by the simplest animals, such as *Amœba*, which may be justly said to be continually engaged in dissolving and then devouring their own framework. In the higher animals, every variety of framework muscular, nervous, glandular, and supporting takes its origin in similar cells made up of the same semi-fluid protoplasm as constitutes the body of *Amœba*. But the failure of the machine theory is most strikingly shown when we consider the development of the organism from the germ-cell.

As Uexküll shows with relentless logic, any mechanical theory of development, whether physical or chemical, necessarily involves an 'architecture of the germ-plasm', that is, a framework of different chemical substances in fixed relations to one another—a miniature replica of the framework of the body—and the discoveries of Driesch prove definitely and finally that such a framework does not exist.

Just as the deepest analysis of an animal's life leads to those 'conscious directive will impulses' which are ultimate and make up its

inner world' or psyche, so the study of development leads us back finally to a series of formative impulses succeeding one another, which Uexküll strangely confuses with the Mendelian 'genes'. The Mendelian 'genes' are simply names for aberrations or weakenings of the normal course of development. They are pathological in origin, as the recent work of Muller has proved, though it was fairly obvious from general considerations before. In the fresh-water shrimp *Gammarus*, on which Dr. E. J. Allen and Mrs. Sexton have carried out such thorough and painstaking investigations at Plymouth, there are no less than eight different kinds of germ-weakening or damage which will turn the normal black eye of the animal into a red one. But if we study the way in which the formative stimuli arise in a normal development which has been completely analysed, such as that of the sea-urchin, we find nothing remotely resembling Mendelian genes. The egg segments and gives rise to a ball of similar cells, and Driesch has proved that these cells are equipotential, each one of them having all the powers of the original cell, and if separated from its normal sisters and forced into a new position it is capable of producing any organ of the larva whatever. Then there comes a change: the protoplasm of one side of the ball can, by intucking, produce a gut—that of the other side cannot. Fresh potencies have been conferred on part of the protoplasm. The nuclei have not altered, all continue to possess the same number of chromosomes, but fresh emanations, most probably ferments, have been emitted into part of the protoplasm.

In later stages of development, Driesch has shown that at first any part of the gut will form a cœlomic vesicle, but that later this power is limited to the swollen tip, and if this tip be cut off, the truncated gut will heal but will produce nothing further. At a still later stage we ourselves have shown that a small segment of the cœlomic cavity known as the hydrocœle will act on the neighbouring skin so as to force it to produce the spines and tube-feet of the adult sea-urchin, and on the neighbouring mesoderm so as to compel it to produce the teeth and other ossicles of Aristotle's lantern. Thus the animal is built up, as Uexküll puts it, by a series of 'impulses' coming into action one after another which 'activate ferments' emitted from the nucleus.

If we examine more closely into the nature of these 'impulses', we find that each one of them is an imperfect repetition often repeated, in a word a blurred memory, of a former functional reaction of the organism to the environment, that is, a former *habit*, and so we discover that the impulses are memories of a series of habits superimposed one on another—a striking parallel on the corporeal side of the Freudian conception of the building up of the mind. It is to be regretted that Uexküll passes over almost completely the *historical* explanation of the structure and function of organisms which is embodied in the idea of evolution. No doubt he is led to this by his repulsion from the loose teleology implied in the Darwinian theory of natural selection. It is wrong, he says, to call one animal more perfectly adapted to its environment than another; the *Amœba* and the lion are equally well equipped to meet the calls which Nature makes on them: what is not well adapted belongs to the realm of pathology and not to biology (as incidentally do all mutations). When the environment changes, the animal within limits has the power of responding to the change, and the vigorous and healthy members of the species do so and pass on this power to their offspring; the 'random' variations in all directions, covertly assumed by Darwinism, simply do not exist.

It would far exceed the limits allowed by the most generous editor were we to attempt a full analysis of this wonderful book. No doubt each one of us who reads it will find something with which to disagree. We have indicated an important point where we are unable to see eye to eye with von Uexküll. We regret also very much that he still clings to the obsolete foam-work theory of protoplasm propounded by Bütschli, and that he accepts the crude theory of the purpose of 'eye' spots on the wings of peacock-butterflies as marks to deceive attacking birds. We have stood in a lane in Cornwall in August with a gorgeous array of admirals, peacocks, tortoiseshells, and other gaudy butterflies on the hedgerows on either side; the air was cleft with the arrow-like flight of low-flying swallows, and they molested the butterflies no more than we did.

Uexküll finds his deepest insight into the nature of life in the conception of *Planmässigkeit*, which we may perhaps translate as 'purposeful striving', and so it turns out that he has independently come to the very same conclusion as our comparative psychologist, William McDougall. Driesch's 'entelechy' is only another way of saying the same thing. Uexküll has earned the right to his opinion by a long series of brilliant researches in comparative physiology. It behoves all who desire to get a thorough insight into fundamental problems to study his book. E. W. MACBRIDE.

Chemistry and Monographs.

The Pyrolysis of Carbon Compounds. By Prof. C. D. Hurd. (American Chemical Society Monograph Series, No. 50.) Pp. 807. (New York: The Chemical Catalog Co., Inc., 1929.) 12.50 dollars.

THE serial scientific literature of the world increases yearly in bulk, and the knowledge contained therein is cumulative. Of all the sciences contributing to this already vast ocean of fact, theory, and opinion, chemistry, in all probability, heads the list, because the field covered by it and its related subjects is greater than that of any other science. The recent issue, in five volumes, of the decennial index of the American Chemical Society came as a startling reminder of what it is now thought proper to include under the head of pure and applied chemistry, and constituted a warning to which other societies, dealing with the publication of chemical abstracts, must have regard. It showed, moreover, that although reference to the original literature is essential to workers in connexion with their activities in some particular field, it cannot be regarded, except in special cases, as a practicable proposition for those who wish to keep abreast of development in sections other than those in which their own work lies. Views change, and much of the published work is subject to correction and alteration as the outcome of further research; a cause of confusion which is enhanced at the present time by the premature publication of results and conclusions by the 'young man in a hurry'.

In earlier days a systematic text-book provided all that was required, and lecturers were in a position to cover, with fair completeness, the whole field of chemistry as then known. But nowadays lectures have to be confined to the enunciation and description of principles, and it is no longer possible for even the most comprehensive of text-books to cover the field of any one of the great branches of chemical science. Recourse had thus to be made to other methods, and in the monograph a means has been found by which it is possible to treat special branches of chemistry in an adequate and reasonably up-to-date manner, which seems to provide a definite solution of the problem. Nevertheless, it is evident that, for any series of monographs to be effective, it must be wisely distributed among the subjects most likely to lead to an understanding of the science as a whole and must not be too specialised in character, and it is clear that this has been the aim before the special committee of the American Chemical Society, under the auspices of which the volume under review has been issued.

It was in July 1919 that the Inter-Allied Conference of Pure and Applied Chemistry deputed to the American Chemical Society the task of producing and publishing scientific and technological monographs on chemical subjects, and it is thus ten years since the Society took over this trust. In that period the Society has issued fifty volumes, which, as a perusal of the publisher's list shows, cover a wide area and embrace a large number of subjects related both to technology and pure science. This is a great record, and one which must be a source of gratification to the Committee and to the Chemical Catalog Company, which has acted as publishers. The book under review is the fiftieth of the series and constitutes a worthy jubilee volume.

At first sight it might be regarded as dangerous to deal with a subject such as organic chemistry from the point of view of some particular behaviour which the substances described show. Conditions of pyrolysis are difficult to determine. There are so many variables which are not subject to complete control: Surface action and the presence of catalysts; secondary chemical changes leading to the formation of products remotely different from those initially formed; products formed by the internal condensation of unstable reactants. These and many other considerations render the field one of the most difficult in modern research. Indeed, it does not appear as if full agreement has yet been reached regarding the behaviour of so simple a substance as methane when subjected to the action of heat. Nevertheless, it may be said at once that the author has succeeded in producing a very readable book, in which, by allocating organic compounds to groups, he has recorded published observations on their behaviour on pyrolysis which, for the first time, enable the reader to see at a glance some of the important changes organic substances undergo in this connexion.

It will probably be a surprise to many people to realise the important part played by pyrolysis in organic chemistry and the wide application it finds industrially. The cracking of petroleum is, for example, one of the most important industrial operations carried out at the present time, and constitutes the means by which much of the petrol required for our modern high-compression engines is produced. Again, the wandering of groups, especially those attached to nitrogen, affords the means by which many of our important dye-stuffs intermediates are manufactured. In the book

under review, organic substances are treated in the order in which they are usually found in organic chemistry text-books; compounds being chosen to illustrate the characteristic behaviour of substances of each group. Whenever any kind of generalisation is possible, it is brought clearly to light, but it is evident that much of the information is disjointed and does not admit of systemisation in the light of our present knowledge. Indeed, it is doubtful whether definite generalisation is possible in the great majority of cases, in the absence of any information regarding the action of catalysts or the surface action of the containing vessel.

Nevertheless, the manner in which the author has searched the literature for examples of pyrolytic change is remarkable, and the bibliography will be found of the greatest value. The book will undoubtedly be of great service to research workers and students, for whilst the method of treatment is unusual, it is none the less thorough and presents the subject from a point of view which has not been hitherto attempted. Like all books issued by the Chemical Catalog Co., it is well printed and the formulæ admirable. J. F. T.

School Physics.

(1) *Light: an Introductory Text-Book.* By C. G. Vernon. Pp. vii + 191 + 2 plates. (Cambridge: At the University Press, 1929.) 3*s.* 6*d.*; with Exercises, 4*s.*

(2) *Intermediate Heat.* By Dr. R. A. Houstoun. Pp. ix + 112. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 3*s.* 6*d.*

(3) *Heat, Light and Sound.* By P. J. Lancelot Smith. (Dent's Modern Science Series.) Pp. 368. (London and Toronto: J. M. Dent and Sons, Ltd., 1929.) 5*s.* 6*d.*

(4) *Energy.* By Sir Oliver Lodge. (Benn's Sixpenny Library, No. 65.) Pp. 79. (London: Ernest Benn, Ltd., 1929.) 6*d.*

THREE of these books are concerned to meet the demands of the First School Examination. With the examination system bulking so unduly in secondary education, the continued making of text-books with this aim is not to be wondered at. Years ahead we may decide otherwise the fate of the would-be science text-books in that day. We may ask: Is this book a distinctive contribution to teaching practice? Will it, in Sir Humphry Davy's words "add some little to the quantity of human knowledge, and of human happiness"? Will it lay the foundation for that appreciation of Nature and her ways on which the growing generation can build with success? Many text-books to-day could claim to pass the first question: how many school text-books could pass them all? For now we must content ourselves with the first question. Each of the following three books meets it with success.

(1) "Light" merits attention. It is a workmanlike attempt to develop an introductory course based on the concept of light as a wave motion, and is well worth the study of those science masters who confine themselves too closely to the old and unappetising course of thinly disguised geometry. Both methods should, of course, find a place in modern educational practice, but in what proportion is a problem for the individual physics master. Further, in the last chapter is a list of suggested experiments using the excellent apparatus of Mr. F. A. Meier of Rugby, described in the *School Science Review*, September 1922, in which "rays fixed by means of pins" are replaced by more illuminating beams. Mr. Vernon finds difficulty, however, in giving the history of his subject. Actually he summarises it in his first chapter. There the beginner meets "Newton's most famous experiment of course is the analysis of sunlight into a coloured spectrum using a prism", something of Snell and Descartes and the law of refraction, the disproof of the corpuscular theory, and so on. The interesting material here would have appeared much better incidentally, or more naturally in a concluding chapter.

(2) This deserves to be a very successful class book. It presents the essential facts concisely, and is developed logically. Many physics teachers must have wished for such a book, which does not rob them of their classical anecdotes or of all their illustrations, but serves as a sound framework for adding all those little things which give class teaching its value. Within the limits of about a hundred pages, Dr. Houstoun has done excellently.

(3) Here, too, is a good text-book. It covers a little more than is needed for matriculation, and is very suitable for work in the two years before that examination, where it is considered advisable to use one text-book only. If supplemented by a good practical course, it can be recommended as a safe and sound book. In dealing with reflection from spherical mirrors on p. 202, an unfortunate prominence is given to the generalisation: "Real images are always inverted". The limitation that this is true of real objects should have been emphasised.

(4) "Energy" should be the well-thumbed possession of every sixth form boy, even though he

is not on the science side. Its author's rare gifts of exposition and illustration are amply illustrated in this little book, which Messrs. Benn have done well to add to their excellent series. It has the distinction, won by all too few physics books, of passing successfully our third question posed above.

A. J. WHITE.

Our Bookshelf.

Éléments d'histologie. Par Prof. P. Bouin. Tome 1 : *Cellule ; division cellulaire ; différenciation cellulaire ; classification morphologique et fonctionnelle des cellules, tissus et organes ; éléments de soutien, contractiles, nutritifs ; sang, lymphe, organes hématopoiétiques, vaisseaux sanguins et lymphatiques.* Pp. vii + 334 + 2 planches. (Paris : Félix Alcan, 1929.) 120 francs.

ALTHOUGH the major part of organic histology remains to be treated in a second volume, and does not come within the scope of this present notice, it may be said that there is now no treatise of medical and general histology which does for English students what this work by the distinguished professor at Strasbourg does for the French. The appearance of the work is a restraining influence upon the increasing detachment of medical training from biological actualities and a check upon the facile conceptualism which makes precise knowledge of the organism a matter of professional indifference. The work is inspired throughout by that 'esprit biologique' which the author deems to be the foundation of medical science, while recognising that his specialty "can no longer limit itself to the study of the minute anatomy of the mammals, but should aim higher and further, concerning itself with some of the questions which preoccupy the minds of inquirers at the present moment".

If the work thus revives a diminished biological faith, it also affords general access to recent accumulations of knowledge, not merely as addenda but also in their proper perspective as parts of an orderly whole. There may be cited the sections dealing with protoplasm from a physico-chemical point of view, microdissection methods applied to karyokinesis; tactisms and tropisms; up-to-date articles on ossification, on joints, on the blood, the blood-vessels, and on the reticulo-endothelial system. Excellent bibliographies are provided to guide the student.

Text-books are, unfortunately, necessary. It is not the fault of any one in particular, but the inevitable fault of all, that they give undue publicity to error. W. Glaser, in pre-War days, figured "fine nerves passing close to a capillary, itself surrounded by somewhat thicker, spirally-arranged nerves". The figure reappeared in Müller's "Die Lebensnerven". Krogh borrowed it for his work on capillaries. It became famous, and many thousands of students have seen it on the lecture-screen. It appears in the present work over the description : "nervous terminations about a capillary, showing the spiral course of nerve fibrils". The vessel is not a true capillary, and the 'nerve' has the familiar features of the spiral muscular loops around small arteries. Although hundreds of investigators must have seen appearances identical with Glaser's photograph, his description —the sole evidence for the double innervation of capillaries—has not hitherto been questioned. The demand for objective verification of physiological theories is responsible for the spread of such legends, but not entirely for their authorship.

TUDOR JONES.

From the Seen to the Unseen. By the Rev. John H. Best. Pp. xii + 552. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1929.) 18*s.* net.

THIS volume is an attempt to examine afresh the established facts and generalisations of modern science, and to ascertain how far such a consideration is capable of an interpretation in harmony with a belief in God as one who not only is absolutely good, but also is an active worker for the realisation of certain far-off beneficent ends.

The opening section of the book deals mainly with matters of a biological order. Mr. Best insists upon the failure to solve the details of embryonic development along the lines of pure mechanism, and in his psychological section he supports this view by pointing out how it would seem that the hypothesis of an inner principle of life is both desirable and necessary. Regarded from this point of view, the phenomena of life suggest to Mr. Best the existence of a supreme intelligence, and, arguing from similar premises, the theory is advanced that, in addition to intelligence and will, such human attributes as feeling and emotion may be added. Man's relation to the deity is then examined, and the conclusion is reached that, since the universe shows manifold indications of purpose in its later evolutionary stages, so the life of man suggests a purpose and a progress towards perfection.

Mr. Best's thesis is not new, but its freshness of treatment and sometimes originality of presentation may make it a valuable aid to those who, not content with a cautious agnosticism, prefer to seek support for their religious speculations in those departments of science which, from their very complexity, may not yet be sufficiently well understood to be described adequately in terms of the known.

The Annual of the British School at Athens. No. 28, Session 1926–1927. Pp. xi + 354 + 23 plates. (London : Macmillan and Co., Ltd., 1929.) 63*s.* net.

IN this volume we have a record of the operations of the British School of Archæology at Athens in the session 1926–27. In addition to the usual report of the Director and the accounts, it contains reports on the work which has been done by members of the School. The major operations continue to be the excavation at Sparta, where in the session of 1927 further work was carried out on the Theatre and the Acropolis. This is described by the Director, Prof. J. P. Droop contributing an

nalysis of the native pottery from the Acropolis nd Mr. W. Lamb a study of the bronzes from the Acropolis and the Orthia site. Mr. W. J. Forsdyke describes his excavation of the Mavro Spelio Cemetery at Knossos. These tombs were discovered n 1926, and the first five excavated by Sir Arthur Evans himself. From one of these came the gold ing with linear inscription described by him in the *Times* of June 8, 1927, in which he ascribed a alismanic meaning to the script. A paper of great nterest is that by Mr. W. A. Heurtley on the xcavation of a prehistoric site at Boubasta on the anks of the Haliakmon in Western Macedonia. The site, though small, was occupied over a very onsiderable period of time from the late Bronze Age. Not only is it interesting in itself as a hillside ettlement, probably of seasonal nomadic shepherds, but it affords Mr. Heurtley the basis for a omparative study of the painted pottery of northern Greece from which he makes some suggestive deductions as to a possible source for the Dorian nvasion.

Biology of the Vertebrates: a Comparative Study of Man and his Animal Allies. By Prof. Herbert Eugene Walter. Pp. xxv+788. (New York: The Macmillan Co., 1928.) 21*s.* net.

THE author states that his book is the outcome of wenty years' teaching of pre-medical students and thers, and in regard to the latter he says: "It s not so generally realised that it may not be miss for every man to gain some inside information about the human mechanism and how it ame to be." That is the keynote of the book. n the first part of the book taxonomy, distribution f animals in space and time, the ancient history f man, cytology, histology, and embryology are onsidered, and there is a short concluding section n biological discords. The second part deals with he skin, alimentary tract, and with the circulatory, espiratory, excretory, and reproductive systems, nd the third part with the skeleton, muscles, ervous system, and sense organs. In the second nd third parts is given an account—necessarily oncise—of the principal modifications of the rgan or system under consideration met with in he vertebrate series, and due reference is made to unctional activities.

To the student who has spent a year or so in oology and desires to proceed further in the study f the comparative biology of the vertebrates, this ook is a handy source of much interesting inormation which he would otherwise have difficulty in finding in small compass. Of the 687 textgures a few are on too small a scale to be really erviceable. Of errors there appear to be relatively ew, but *Xenopus* is not, as is stated, South merican.

ice Engineering. By Prof. Howard T. Barnes. Pp. vi+364+ii. (Montreal: Renouf Publishing Co., 1928.) 5 dollars.

TWENTY years ago, Prof. Barnes published his ork on "Ice Formation with Special Reference o Anchor Ice and Frazil", and in the lengthy bibliography contained at the end of his new work on ice engineering will be found many papers by him on various aspects of the ice problem. His life-long study of the blocking of the rivers of North America by ice and of the icebergs of the North Atlantic, led him to the discovery of the value of thermit for breaking up great masses of ice, and in 1925 he was granted a patent by the United States for his process. Thermit, it will be recalled, was discovered in 1895 by Dr. Hans Goldschmidt, who died in 1923. It is a mixture of aluminium powder and iron oxide which, when ignited, produces intense heat in a very short time. As applied by Prof. Barnes, thermit has been used for clearing the streams leading to power houses, for the prevention of floods, and for the breaking-up of icebergs, and only last winter the Canadian Government entered into a contract involving an expenditure of some £12,000 for an experiment on a large scale for the prevention of ice-jams on the St. Lawrence.

Details of some of the work done by Prof. Barnes is given in this volume, which, however, also deals with the physical properties of ice, the theory of the formation of anchor ice, ice remedial work, ice navigation, ice breaking, and other aspects of the subject. The bibliography is classified and chronological and contains references to papers by Boyle, Gay-Lussac, Faraday, Forbes, Kelvin, and other famous investigators.

Handbuch der regionalen Geologie. Herausgegeben von Prof. Dr. G. Steinmann und Prof. Dr. O. Wilckens. Band 7, Abteilung 7a: *The Union of South Africa.* By A. W. Rogers, A. L. Hall, P. A. Wagner and S. H. Haughton. Pp. 232+3 plates. (Heidelberg: Carl Winters Universitätsbuchhandlung, 1929.) 17 gold marks.

THESE 'handbooks' are indispensable works of reference for the countries they describe. The first part of the seventh volume deals with the Union of South Africa. The sections by the four main authors are supplemented by contributions by Dr. J. L. Krige, Dr. du Toit, and Prof. Shand. The book, as might be expected from the authors, deals mainly with the work of the Geological Survey, and includes a useful list of its maps and publications. The work is shorter than the volumes by du Toit and Krenkel, and its special value is as an authoritative statement of the present conclusions as to the classification and correlation of South African rocks. It may be noted that the Stormberg Series is all included in the Trias; the system in which the Ecca Series should be included is left indefinite; and the Waterberg System, from which the beds below the unconformity in it are excluded and referred to the Transvaal System, is accepted as pre-Palæozoic.

The section that is of particular value is the account of the complex and long series of rocks included in the pre-Palæozoic. The economic section by Dr. Wagner has an interesting account of the occurrence and distribution of the platinum ores.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts, intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Observations of the Total Eclipse of the Sun at Alor Star, Kedah, on May 9.

THE observations attempted by British observers at the total eclipse of the sun on May 9 were almost completely spoilt by cloud. At Alor Star in Kedah, the sky was covered throughout the day of the eclipse by high cloud through which the sun could generally be dimly seen. The prearranged programme was carried out, but the stars in the sun's neighbourhood did not show on the plates and the spectroscopic observations also failed.

Better success was obtained with the 6-inch lens of 45 feet focus which was used at Giggleswick, and the loan of which was extended by Mr. Worthington

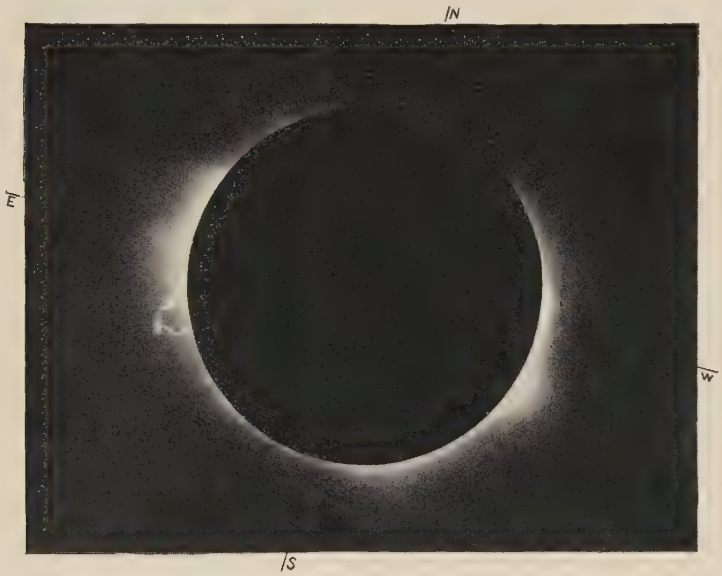


FIG. 1.

to this eclipse. The series of exposures from 3^s to 20^s were intended to show the prominences and the form of the inner corona. Although the longest exposure does not show more extension than was expected to be obtained from the shortest in a good sky, and although the longer exposures show a good deal of scattered light within the dark circle of the moon, the five plates give excellent pictures of the brighter details. The definition was excellent, such as it often is through cloud, and all the five plates show the same irregularities in the moon's limb. The reproduction (Fig. 1) is from the plate exposed from 200^s to 210^s after the beginning of totality. The filamentous prominence on the east limb is 180,000 miles long and 120,000 miles high—one of the largest ever photographed, though much inferior to that of 1919, especially in brilliance. The photographs taken near the beginning and end of totality show considerable differences in the structure of this prominence. On the western limb a beautiful coronal arch, besides much other detail, can be seen. The observers noted a considerable amount of red on this side of the eclipsed sun before the end of totality, but they did not see the large prominence on the eastern limb.

Small scale photographs were also secured through red filters. Those on kryptocyanine plates show the form of the corona best. The corona is of intermediate form and shows considerable difference from that generally obtained at sunspot maximum. On the panchromatic plates, also exposed through a red filter, the coronal extension is confused with the scattered light.

Photographic reproductions on paper 12 in. by 15 in., similar to those made from the photograph taken at Giggleswick, can be obtained from Mr. F. Jeffries, Royal Observatory, Greenwich, price 2*s.* 6*d.* each.

J. JACKSON.

Royal Observatory,
Greenwich, S.E.10, July 6.

A Possible Origin of Faint Fraunhofer Lines.

THERE are about 20,000 lines in the Fraunhofer spectrum of the sun (excluding the infra-red part), of which only about 6000 have been correctly identified with the lines of known elements, and with the lines of certain band spectra (cyanogen, Swan, etc.). The origin of the others is still wrapped in mystery. Possibly a large number may be found to coincide with the fainter lines of complicated spectra of elements like iron, nickel, etc., particularly with those belonging to higher Rydberg sequences. For some time past we have been thinking of a third possibility of the origin of these lines, namely, whether a large number may not be ascribed to the combined effect of Raman scattering and ordinary absorption. For example, molecules which are responsible for the emission of the cyanogen and Swan bands are strongly present in the sun, and when a beam of light falls on them from the photosphere, this light may be supposed to be modified by Raman scattering to the frequency $\nu - \nu'$, where ν' is some frequency corresponding to a strong vibration-rotation frequency of the CN-molecule. If $\nu - \nu'$ happens now to coincide with the H or the K frequency, the modified light will be absorbed by the high level Ca^+-atoms, and we shall get an absorption line in the place of the original frequency ν.

Taking the strong vibrational-rotational frequencies of the CN-molecule (particularly those which are expected to be strong at the solar temperature), I have calculated the lines which, after being modified by Raman scattering, are absorbed by the Ca^+-atoms. I have obtained lines which agree very closely with Fraunhofer lines of intensity $(-3, -2, -1)$ for both H- and K-lines. Some calculated lines coincide with the recorded faint lines of other elements. But even leaving these aside, the evidence obtained is strongly in favour of the view presented in this note. If we calculate the lines modified by such molecules as H_2, which are known not to occur in the solar spectrum, the coincidences are found to be either entirely lacking or rather poor.

Of course, in the circumstances, it is impossible to get absolute confirmation of the view, but probably a plausible case has been made out that Raman scattering may be responsible for the origin of a large number of faint Fraunhofer lines. If the view be correct, it will afford us a method for calculating the total number

f molecules of CN in the solar atmosphere from a omparison of the intensities of the modified line with hat of the K-lines, with the aid of known dispersion ormulæ.

It may be mentioned that this investigation was riginally undertaken with the view of finding out whether some of the lines of the coronal spectrum may ot be due to Raman scattering of strong Fraunhofer nes by molecules on the sun. Though certain triking coincidences were obtained, for example, the requency of the green coronal line λ5303 comes out to e equal to $\nu - \nu'$, ν = frequency of the K-line, ν' is a trong vibrational-rotational frequency of the H_2-nolecule, the corresponding modified frequency for he H-line was found to be absent, and hence the view vas abandoned. It does not appear that the coronal pectrum is due to modification of strong Fraunhofer nes by Raman scattering.

My best thanks are due to Prof. M. N. Saha for indly suggesting the problem and for his continual uidance.

Daulat Singh Kothari.
Department of Physics,
University of Allahabad,
June 1.

Fine Structure in the Helium Band Lines.

As is now well known, the electron levels of He_2 all into two systems, p-He_2 and o-He_2, paralleling the -He and o-He terms. The o-He_2 and p-He_2 levels e, on theoretical grounds, probably respectively triplets and singlets like the corresponding atomic levels (cf. especially W. Weizel, *Zeits. f. Physik*, **51**, 328; **52**, 175; **54**, 321; 1928–29). But no evidence of triplet structure in the o-He_2 levels has been reported, except probably in one perturbed 5π rotational level (cf. G. H. Dieke, Nature, Mar. 23, 1929). This is not altogether surprising, since the o-He terms show only very narrow fine structures, the largest separations being in the $2\,^3P$ term ($^3P_0 - {}^3P_1$, $\Delta\nu = 0{\cdot}991$, $^3P_1 - {}^3P_2$, $\Delta\nu = 0{\cdot}077$).

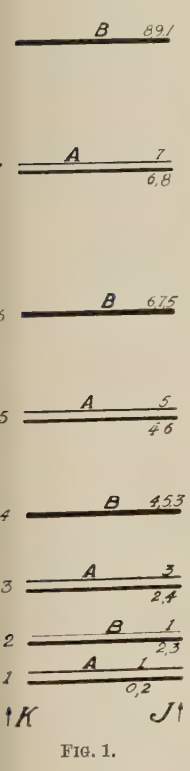


Fig. 1.

On photographing the He_2 bands with somewhat higher resolving power than hitherto, we have found fine structure in the lines of a number of o-He_2 bands having $2\,^3\pi$ as their lower electronic state. On the other hand, the $2\,^3\Sigma - 3\,^3\pi$ band λ4650 shows no evidence of fine structure.

The bands λ6400 ($2\,^3\pi - 3\,^3\Sigma$), λ4546 ($2\,^3\pi - 4\,^3\Sigma$), and λ5733 ($2\,^3\pi - 3\,^3\Delta$) all show qualitatively the same fine structure for all band lines which end on any given rotational level, but the quantitative separations appear to be smaller in some of the λ5733 lines. Other bands ($2\,^3\pi - 3\,^3\chi$ and $2\,^3\pi - 4\,^3\chi$) show similar relations.

We conclude that the observed band-line patterns re mainly determined by the fine structures of the otational levels of the $2\,^3\pi$ state, and that the fine tructures of the other states involved are smaller $^3\chi$, $3\,^3\Delta$) or negligible (probably, $^3\Sigma$ states). The ccompanying diagram (Fig. 1) shows the lower otational levels of the $2\,^3\pi$ state, correctly spaced, ut with the fine structures exaggerated twenty-five-old. The fine structures shown are drawn the same as those observed for the λ6400 band lines. The doublet separations, as measured for successive A levels, diminish slowly from $\Delta\nu = 0{\cdot}34$ for the lowest level, but the intensity ratio (about 2 : 1 in favour of the high-frequency component) appears to be constant. For the lowest B level, $\Delta\nu = 0{\cdot}25$, with the long-wave component very weak, while succeeding levels are merely broadened.

The $2\,^3\pi$ fine structures may be interpreted as follows. If K is the rotational quantum number when the spin S is neglected, one expects for triplets ($S = 1$) a fine structure with three levels ($J = K$, $K \pm 1$), each having a statistical weight $2J + 1$. Suppose, for given K, the levels with $J = K \pm 1$ approximately fall together, while $J = K$ is distinct; the composite $J = K \pm 1$ then has twice the weight of the level $J = K$. This supposition explains well the observed relations in the A class of rotational levels. (This fine structure type is apparently similar to that observed in the $^3\Sigma$ normal state of O_2; cf. Mulliken, *Phys. Rev.*, **32**, 880; 1928: Kramers, *Zeits. f. Physik*, **53**, 422; 1929.) To explain the B level fine structures we may assume that $J = K$ and $J = K + 1$ approximately fall together for $K = 2$, while $J = K - 1$ lies higher; but that for $K = 4$, 6, . . . the three levels $J = K$, $K \pm 1$ are only sufficiently separated to give a broadening without resolved fine structure. The assumption made for $K = 2$ would give a 4 : 1 intensity ratio for the members of the observed doublet, in harmony with the estimated experimental ratio.

The Zeeman effect of these He_2 bands is also of interest. In a field of 30,000 gauss the Q (1) line of the λ6400 band becomes in parallel polarisation a doublet of width $\Delta\nu_n$, in perpendicular polarisation a corresponding triplet, the components being very sharp in each case. The unresolved patterns of the higher Q lines in parallel polarisation, and of the P and R lines in perpendicular polarisation, appear as doublets. The results are exactly what theory predicts for singlet levels (cf. Curtis and Jevons, *Proc. Roy. Soc.*, A, **120**, 110; 1928). The original fine structure is evidently wiped out here by a Paschen-Back effect.

Further details will be given elsewhere.

G. S. Monk.
R. S. Mulliken.
Ryerson Physical Laboratory,
University of Chicago,
June 1.

Use of the Thermionic Valve in Measurements of Ionisation Currents.

Owing to the extremely high humidity of the atmosphere in many parts of the east, the use of the quadrant electrometer for the measurement of ionisation currents is limited to a few months in the dry season. Recently we had occasion to demonstrate some of the ordinary experiments on the properties of ionisation currents, and found the following device quite satisfactory. In Fig. 1, AB is an ordinary ionisation chamber of which the upper plate A is connected to a battery of cells B_2, the lower plate B, on which is spread uranium oxide, being connected to earth through a high resistance R. This high resistance is inserted in the grid circuit of the valve V (Mullard type I.H.F.). Initially, with the key K open, the anode current is compensated by the potential balancing device Z, so that the galvanometer indicates zero. On closing the key the ionisation current flows through R, the grid potential is altered and the galvanometer is deflected. Varying the voltage on A, the ordinary increase of ionisation current up to saturation can thus be recorded.

The resistance R consists of a mixture of xylol and alcohol (10 : 1) contained in a sealed quill tube 20 cm. long. It had a resistance of approximately 10^{11} ohms as determined by the leakage method. Z would be, perhaps, 4000 ohms.

Experiments are now in progress to test the application of this method to the absolute measurement of ionisation currents. With a resistance of 10^{11} ohms a current of 10^{-12} amp. should produce a voltage on the grid of 10^{-1} volt, and hence an alteration of anode current for the type of valve used of about 20 microamp., which could be recorded on an

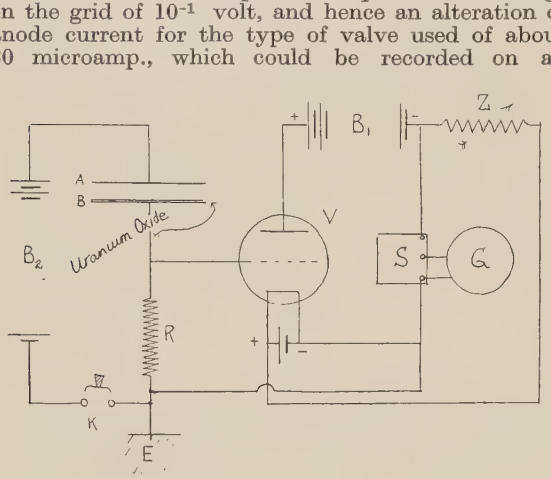


FIG. 1.

ordinary unipivot galvanometer. Still smaller ionisation current should be measurable with equal accuracy by employing still higher resistances. Whilst responding to the ionisation produced by X-rays, this method is unsuitable owing to the extreme sensitivity of the valve to high frequency disturbances. It is possible, however, that this difficulty may be overcome by careful screening. Unsteadiness due to capacity effects is very much minimised by operating the key from a distance. The possibilities of this method are now being investigated, and it is hoped to publish the full details in the near future.

I am much indebted to Mr. N. G. Srinivasan, who made the high resistances used and assisted me in setting up and carrying out the experiments.

J. A. C. TEEGAN.

University College,
Rangoon, April 21.

A Relation between Raman Spectra and Ultra-Violet Absorption.

IT is well known that the Raman frequencies are identified with vibration frequencies of the molecule, and this is corroborated by the agreement already found between Raman lines and absorption bands in the infra-red. It is to be anticipated, however, that a polyatomic organic molecule with its several frequencies of vibration would give a rather complicated absorption spectrum, so that the dispersion of the spectroscope in the infra-red is often insufficient for their resolution. The result is therefore a superposition of bands on a continuous background, the maxima of which may correspond to average values between two or more bands. In fact, the agreement between Raman spectra and infra-red absorption is in many cases not quite satisfying.

For the ultra-violet absorption spectrum of vapours the experimental conditions are better. Many organic substances yield absorption spectra consisting of well-resolved bands, and with the high dispersion available in this region, these can be measured with great accuracy.

Following up a suggestion made by Prof. V. Henri that the Raman spectra give the possibility of determining the vibrational frequencies of the normal state, a comparison was made of the ultra-violet absorption and Raman spectra of several compounds.

Chlorbenzol shows this relationship very clearly and was therefore chosen for a more complete study. The absorption spectrum of chlorbenzol vapour consists of numerous bands and lines (about 350 measured) extending from 2780 A. to 2250 A. Under the assumption that the strongest band in the spectrum is due to the electronic transition from the lowest level in the normal state to the lowest level in the excited state, a general analysis of the spectrum is possible by means of the Raman frequencies. From this band, $\nu_0 = 37052{\cdot}9$ cm.$^{-1}$; in the direction of longer wave-lengths there are a number of weaker bands at frequencies agreeing with the Raman frequencies. In the same way, going out from strong bands farther in the ultra-violet, which correspond to higher vibrational states of the excited molecule, similar weak bands are to be found toward longer wave-lengths, which again show separations equal to the Raman frequencies.

The frequencies measured in this way in the ultra-violet spectrum, compared with the Raman frequencies (in parenthesis), as measured in this laboratory are, in cm.$^{-1}$: 201·9 (196), 242·1 (242), 418·9 (420), 618·6 (618), 622·9 (618), 707·9 (706), 822·7 (823), 1004·8 (1005), 1024·6 (1025), 1087·1 (1088), 1157·2 (1162), 1585·0 (1583), 3063·3 (3064). The analysis of the spectrum shows that the strongest frequencies of vibration in the excited state are : 318·8, 519·0, 523·9, 929·8, and 962·6 cm.$^{-1}$.

The level corresponding to the Raman line 618 cm.$^{-1}$ is found to be double in the ultra-violet absorption, and the corresponding level in the excited state is also double. As the separation of these doublet levels increases proportionally with the quantum number, it is possible that an isotope effect due to the chlorine atom is the factor responsible for the doubling.

The complete analysis of the ultra-violet absorption spectrum of chlorbenzol will appear shortly elsewhere.

A. LANGSETH
(Fellow of the Rockefeller Foundation).
Physikalisch-chemisches Institut
der Universität, Zürich,
June 16.

Raman Effect in Carbon Dioxide.

IN NATURE of Feb. 9, F. Rasetti has published his observations on the Raman effect in carbon dioxide. He has found the lines at λ4639, λ4616 and λ4289, λ4268, excited respectively by the mercury lines at λ4358·343 and λ4046·560. These modified lines are due to the following transitions :

λ.	ν.		ν.	μ.	μ.
4358·343	22943·35	Diff.	1285·62	7·776	7·788
4616·000	21657·73				
4046·560	24705·40	Diff.	1281·80	7·799	
4268·000	23423·60				
4358·343	22843·35	Diff.	1393·00	7·177	7·168
4639·000	21550·35				
4046·560	24705·40	Diff.	1396·48	7·159	
4289·000	23308·92				

The lines thus correspond to an absorption band near about the region 7·8 μ, having for its components the radiations due to 7·788 μ and 7·168 μ. These components may be due to changes in the vibrational

states, one to a transition from state 0 to state 1, the other from state 1 to state 0. Both these states may be expected to occur under ordinary conditions when the moment of inertia of the molecule is large, as in the case of carbon dioxide.

These modified lines show that the model of carbon dioxide is a linear one as considered by Eucken (*Zeits. f. Physik*, **37**, 714; 1926), who has calculated the frequency corresponding to the vibration along the direction joining the C- and O-atoms to be of that of an anharmonic oscillator having a frequency corresponding to 7·86 μ—this frequency being optically inactive in the case of absorption. In the case of scattering, this frequency will evidently be the one which will be the most prominent. Of the other two fundamentals at 4·25 μ and 14·87 μ, one may be optically inactive in the case of scattering, and the intensity contribution of the other may be so feeble that it would require a very large exposure to show its presence. It may here be pointed out that the pair of bands at 2·7 μ, which has been considered as a fundamental by Schaefer and Phillipps, has been shown by Eucken as due to combination frequencies, and one is not justified in considering it as a fundamental due to its weak intensity. That the carbon dioxide molecule has a linear model is also shown by the absence of a permanent dipole moment and from the ordinary scattering data.

Thus the observations of Rasetti are a very clear proof not only of the Raman effect, but also of the linear model of carbon dioxide. It is also expected that in the other triatomic molecules where the dielectric constant data show the absence of a permanent dipole moment due to linear structure with symmetrical disposition of the two atoms on each side of the central one, the Raman effect would be shown evidently with less exposure for the optically inactive fundamental frequency in absorption.

P. N. GHOSH.
P. C. MAHANTI.

Applied Physics Laboratory,
University College of Science,
92 Upper Circular Road, Calcutta.

Further Investigation on Incoherent Scattering in Gases.

IN letters to NATURE, and in two papers published in the *Proc. Nat. Acad. Sci.* of America, I have reported some results obtained on the Raman effect in gases. I want to report now about some new experiments, which will be more completely described in the *Physical Review*.

I have observed, for the first time, so far as I know, a purely electronic transition in the scattering process. The molecule NO has a normal ^2P state, the separation of the doublet being about 124 cm.$^{-1}$; the two levels arise from the two opposite orientations of the electronic spin relatively to i_1, that is, to the nuclear axis. I have found this transition in the Raman spectrum excited by λ2536.

I have built a new apparatus in order to work with gases at 10 atmospheres pressure, with ultra-violet excitation. In this way I have obtained beautiful Raman spectra of hydrogen. They show eight lines corresponding to purely rotational transitions, and also well-developed vibrational-rotational Raman bands, of which so far only unresolved Q-form branches had been recorded. I have measured now three lines of the Q-form branch, four of the RR-form branch, and one of the PP-form branch for the transition from the zero to the first vibrational level.

From this, not only the moment of inertia and the vibration frequency of the H_2 molecule can be calculated with high accuracy, but also the coupling between rotation and vibration.

Gaseous hydrocarbons at ten atmospheres give strong Raman lines in a few hours' exposure. Systematic work is being extended in this direction.

F. RASETTI.

California Institute of Technology,
Pasadena, June 1.

Statistics in Biological Research.

IN the review of Dr. R. A. Fisher's "Statistical Methods for Research Workers" in NATURE of June 8, the point is made that a careless reader may get the impression that the various methods outlined therein will give exact results when applied to the ordinary small 'sample', although we have, in general, no proof, or even expectation, that the sample is drawn from a 'normal' population, to which alone the tables can be exactly applied. That this is so is clear from the fact that an American writer has stated that the English school of statisticians claims to have produced tables which may be used for samples, however small, drawn from any conceivable population; but of course Dr. Fisher would be the first to cry out against the foolishness of making any such claim.

That such a misconception should arise is perhaps not unnatural when a mathematician is trying to explain what he has been doing to those who lack the mathematical outlook, but this would presumably not apply to the reviewer; yet by his use of the word 'admit' when doubtless he meant 'stress' ("It would seem wiser . . . to admit the incompleteness of theory . . .") he runs the risk of seeming to support a misstatement which Dr. Fisher may well resent.

The question of the applicability of normal theory to non-normal material is, however, of considerable importance and merits attention both from the mathematician and from those of us whose province it is to apply the results of his labours to practical work. Personally, I have always believed, without perhaps any very definite grounds for this belief, that in point of fact 'Student's' distribution will be found to be very little affected by the sort of small departures from normality which obtain in most biological and experimental work, and recent work on small samples confirms me in this belief. We should all of us, however, be grateful to Dr. Fisher if he would show us elsewhere on theoretical grounds what *sort* of modification of his tables we require to make when the samples with which we are working are drawn from populations which are neither symmetrical nor mesokurtic.

"STUDENT."

The Galton Laboratory,
University College,
London.

The Long Period Variations of UZ Persei.

IN *Harvard College Observatory Bulletin*, No. 867, Feb. 1, 1929, there is a note by B. P. Gerasimovič on "UZ Persei, a Variable of Unusually Long Period". The author found that the brightness of this variable star has two oscillations—short and long—with periods of about 90 and 907 days respectively. It is known that such oscillations are typical for μ Cephei.

In a short note (*Astronomical Bulletin*, Mirowedenije, Nr. 22, 1928) I showed from 3785 observations that μ Cephei has three oscillations. The periods of these oscillations are 90 days, 600 days and 13 years. The most interesting is the last oscillation, on account

of its long period and distinctly observed amplitude 0·5 st. mag.

It was interesting to look for this long period in the case of UZ Persei. Indeed, Mr. Gerasimovič's light-curve shows that the brightness at minima and maxima does not remain constant, but varies slowly.

It may be seen from the accompanying table that

Minimum I.D.	mag.	Maximum I.D.	mag.
2,417,450	10·85	2,416,800	10·56
8,300	10·90	7,800	10·55
9,200	11·00	8,700	10·62
2,420,200	10·88	9,700	10·57
1,100	10·72	2,420,800	10·45
2,000	10·75	1,550	10·48
..	..	2,400	10·52
Range	10·72-11·00	Range	10·45-10·62

there is a secular oscillation with a long period of about 5000 days or 14 years, and amplitude 0·3 mag.

It is clear that this star is of μ Cephei type. My paper on μ Cephei and the principle of classification of irregular variable stars of this type will be published later. W. ZESSEWITSCH.

University Observatory,
Leningrad, May 18.

Rapid Approximate Calculation.

FOR all work in which an error up to 10 per cent in the final result is admissible, the following rough logarithm-table provides a means of multiplying and dividing which is appreciably more rapid than direct calculation, and in simple cases does not require pencil and paper.

Log..	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
No. .	5/4	$\pi/2$	2	5/2	π	4	5	2π	8

With some of the figures, of course, everyone who has occasion to use logarithms at all is familiar; that the logarithms of $\pi/2$ and 2π can be obtained from that of π by subtracting or adding 0·3 is also in itself self-evident; nevertheless, it seems worth while to point out explicitly how very convenient it is to be absolutely familiar with the whole table. The error in every case is less than 1 per cent, and with a little practice it will be found possible also to estimate very quickly the second place of decimals for any number at all, with an error that is usually less than 1. An error of 4 in the second place, corresponding to 10 per cent in the number, should then occur only in the results of fairly complicated calculations.

An error in the decimal point is much less probable than when working with the slide-rule; the method is in fact very reliable for fixing the position of the decimal point in slide-rule results. Its principal other applications are obviously for estimating whether a theory or an experimental method is roughly suitable for a particular purpose, and for checking the experimental results of students in cases where a numerical slip is suspected.

R. D'E. ATKINSON.

Berlin, May 29.

The Spectrum of the Corona.

IN view of the interest attaching to the identification of the unknown lines of the solar corona, I have examined the possibility that they might be due to the occurrence of 'forbidden' transitions between terms in the spectra of ionised iron (Fe II), calcium (Ca II), titanium (Ti II, Ti III) and argon (Ar II), as well as several important forbidden transitions of the neutral titanium atom.

Ionised iron, calcium and titanium are all present at high levels in the chromosphere, and although there is no indication that argon is present, it was examined in consequence of a suggestion, now disproved by H. N. Russell and I. S. Bowen (*Astrophysical Journal*, **69**, 196; 1929), that the coronal lines might arise from neutral argon. Wave-lengths corresponding to some 500 forbidden transitions have been computed, but in no case have any coincidences been found between these and the coronal wave-lengths which would not be considered a pure matter of chance. Similar calculations seem to have been made by I. S. Bowen and D. H. Menzell (*Publ. Astro. Soc. Pac.*, **40**, 322; 1928), but details of this publication have not been available to me.

Another possibility that the coronal lines might arise in second type collisions involving the metastable 1δ terms of ionised calcium (Ca II) is under consideration, but has so far also yielded negative results. E. M. LINDSAY.

Department of Physics,
Queen's University, Belfast,
July 3.

The Ovarian Hormones.

THE writer of an article on "The Hormones of the Sexual Glands" in NATURE of June 15, p. 913, says that "the œstrous reaction of ovariectomised animals following an injection of 'œstrin' appears incomplete, in that copulation is only infrequently observed, and in the spayed bitch the hormone only produces symptoms of pro-œstrus, so that possibly the missing factor may be the hormone responsible for the initial development of the accessory sex organs". The reference is probably to a paper by Dr. S. A. Asdell and myself published in the *Proceedings of the Royal Society* (1927), but it is to be pointed out that the injections described in that paper were made into anœstrous bitches and not into spayed ones. The argument above quoted, therefore, does not apply. I write open to correction and without the references before me, but I believe I am right in saying that Dr. Wiesner of Edinburgh has concluded from experimental evidence that more than one ovarian factor is concerned in the production of pro-œstrum and œstrus. F. H. A. MARSHALL.

Beresford, Yarmouth,
Isle of Wight,
June 21.

THE paragraph to which Dr. Marshall refers was based on two statements made by Parkes in his review of ovarian activity (*Biol. Reviews*, vol. 3, pp. 212 and 213; 1928), quoting papers by Parkes, Fielding and Brambell (*Proc. Roy. Soc.*, vol. 101; 1927) and by Asdell and Marshall, the paper to which Dr. Marshall refers. Parkes found that of 92 induced œstrous periods in ovariectomised mice kept with males, only 7 were accompanied by copulation; of these 7, 3 occurred in mice which were found to have regenerated ovarian tissue. I had not referred to the original papers when writing the article and accept Dr. Marshall's correction. On the other hand, the failure of the injections in Dr. Marshall's experiment to provoke the full œstrous reaction surely indicates that a further factor is required, unless it is assumed that some inhibiting factor is present in the anœstrous bitch. THE WRITER OF THE ARTICLE.

Mineral Metabolism: Iodine and Sulphur.

THE importance of the mineral salts in nutrition is sometimes obscured by the greater attention devoted to other dietary constituents, more especially within recent years to the vitamins; but, of course, they are just as important for life as any of the other irreplaceable elements of the diet. The functions of the chlorides of sodium, potassium, and calcium in maintaining the osmotic equilibria between the fluids and cells of the body, without which the latter cannot function normally, the necessity of a supply of calcium and phosphorus for the formation of bone, and of iodine for the production of thyroxine, and the part played by the sulphur-containing amino-acid, cystine, in growth, all indicate the importance of studies of the mineral metabolism.

The functions of iodine and sulphur in the animal economy offer some interesting analogies as well as points of contrast, and have recently been reviewed by Orr and Leitch,[1] and Marston and Brailsford Robertson,[2] respectively. Our knowledge of the metabolism of these two elements, although extensive, is still incomplete at many points, but critical reviews are of value by indicating both the present position of our knowledge and also the points at which further work may be at the moment most profitably carried on. The present article will summarise briefly some of the more salient features of the positions of iodine and sulphur in nutrition and metabolism.

Iodine.

It is of interest to note that the work of the first quarter of the twentieth century has been largely a repetition of that carried out during the first half of the nineteenth, with the result that the earlier conclusions have been essentially confirmed, although the investigations were performed with few of the modern facilities for accurate research work which we now possess.

Iodine is very widely distributed in Nature, but it is usually present in only minute amounts. Even in its richest sources, such as saltpetre deposits and sponges, its maximum concentration does not exceed 0·1-0·2 per cent. In other minerals or animal tissues the amount present may be reckoned in thousandths of a milligram. It has been found in all geological deposits examined in concentrations varying from 170 γ to 9200 γ per kgm. ($\gamma = 10^{-6}$ gm.); in soils it occurs in quantities varying from 600 γ to 6000 γ per kgm.; it tends to be absorbed by acid soils and is concentrated by the plants growing on the soil, both processes leading to enrichment of the soil. On the other hand, depletion occurs in basic soils or those rich in calcium and also in heavily cropped soils. Water contains much less iodine than soil; fresh, 1 γ per litre, and salt, 17-18 γ per litre; marine plants and seaweed concentrate the iodine from sea water and form rich sources of the element. Only traces are found in salt deposits or in air.

It thus appears that plants must provide the main source of iodine for animals, and it is of importance to know something of the factors affecting the iodine content of the former. The available iodine in the soil, which may not be the same as the total iodine, is of much greater importance in determining the iodine content than the species to which the plant belongs; but the actual part of the plant in which the concentration is highest varies with the species. Sea plants contain the most iodine and land plants the least, with freshwater intermediate. The effects of supplying additional iodine for plant assimilation depend on the dosage used, the species of plant, and the medium to which it is added. In general, it may be stated that with the amount of iodine available at its optimum level, growth is at its maximum, and the iodine concentration and nitrogen assimilation are increased; the storage of useful products, for example, sugar in the sugar-beet, is improved, and there is also an increase in the aerobic respiration, and in the *p*H of the cell sap; the activity of nitrifying bacteria is stimulated. Doses greater than the optimum are toxic, but the amount required to produce such an effect varies with the species of plant studied.

In animals, the iodine content of the thyroid gland reaches 0·1-0·2 per cent or more of the dry weight, but the concentration in the other tissues of the body is much less. At present the only known function of iodine in the animal economy is in the formation of thyroxine, a stimulator of metabolism and essential for growth and health. In addition to thyroxine, the thyroid gland also contains di-iodo-tyrosine, and it appears probable that these two compounds account for the whole of the iodine content of the gland (C. R. Harington and S. S. Randall: *Chem. and Indust.*, vol. 48, p. 296; 1929). The latter is influenced by a number of factors, but depends chiefly on the intake of iodine and less upon the age, sex, or species. The differences between individuals of the same species are as wide as any differences between species, except that the glands of sea fish contain up to 1·6 per cent iodine (dry weight), whilst those of rats appear to have a low content, 0·06 per cent (dry weight) having been reported, but these differences are probably explicable by varying levels of intake. In normal glands the total iodine content increases with the age of the individual as the gland grows to its maximum in adult life, the iodine percentage remaining fairly constant; only in the very young fœtus is the percentage lower. In some animals the iodine content is greatest in autumn, coincident with an increase in the iodine content of the pasture; the percentage also varies inversely with the

[1] Medical Research Council. Special Report Series, No. 123: Iodine in Nutrition; a Review of Existing Information. By J. B. Orr and I. Leitch. Pp. 108. (London: H.M. Stationery Office, 1929.) 2*s*. 6*d*. net.

[2] Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 39: The Utilization of Sulphur by Animals, with Especial Reference to Wool Production. By H. R. Marston and T. Brailsford Robertson. Pp. 51. (Melbourne: H. J. Green, 1928.)

weight of the gland, but this is only true of normal glands.

The concentration of iodine in other tissues is low, for example, 5-15 γ per 100 c.c. of blood, rising in women at the beginning of menstruation, doubtless due to change in the physiological activity of the thyroid gland with the sexual cycle. The body tissues generally account for 40-80 per cent of the total iodine, according to the species, the remainder being in the thyroid gland.

The effects of the administration of iodine to animals are in many ways similar to those produced by feeding thyroid gland itself, since the iodine may modify the gland's secretion. Both inorganic and organic iodine occur in the blood; the former is passing to the gland or results from the disintegration of thyroxine in the cells of the body. The latter is probably chiefly thyroxine itself, on passage to the tissues of the body, since its amount is decreased after thyroidectomy. It may be pointed out here that inorganic iodine can be readily assimilated by the body, whereas inorganic sulphur cannot be utilised, only organic compounds of the latter being taken up and metabolised.

Iodine may produce increased growth in animals and in children in goitrous areas, but such a result appears to be presumptive evidence that the intake was previously below the optimum. On the other hand, thyroid administered in excess can inhibit growth, acting as a toxic agent. Small doses of iodine or thyroid increase the retention of nitrogen, whilst the larger doses of the latter increase its output; coincident with these effects, thyroid administration stimulates the general metabolic processes of the whole body, whilst small doses of iodine may, under certain conditions, decrease these, at the same time decreasing the organic iodine in the blood.

Light has been thrown on the physiology of the thyroid gland by studies of its diseases. A healthy gland stores colloid in its acini, but this only occurs where the iodine content is about 0·1 per cent of the dry weight, or 0·03 per cent of the fresh weight or more; hence an adequate intake of iodine is essential for the proper functioning of the gland. In both simple and exophthalmic goitre the percentage of iodine is subnormal. The variations in the supply of thyroxine to the tissues are reflected in alterations in the concentration of iodine in the blood.

Data from metabolism experiments and the average iodine intake in non-goitre as compared with goitre areas indicate that the minimum daily amount required for equilibrium is, in the adult, 15 γ, and in the child, 50 γ, but to allow a liberal margin of safety, at least three times these quantities should be consumed. Endemic goitre can be prevented and usually cured by supplementing the iodine intake, and it has been found that about 100 γ daily are required; this amount can be conveniently obtained by using salt to which a small dose (1 : 200,000) of potassium iodide has been added.

To sum up, animals can obtain the iodine they require from such a source as an inorganic iodide, or iodine itself may be administered; usually the requisite quantity is consumed with the animal or vegetable food eaten, partly in inorganic and also probably partly in organic form, but little is known of the organic iodine compounds in plants. In animals the iodine is taken up by the thyroid gland, for the formation of thyroxine, di-iodo-tyrosine presumably being an intermediate stage. The thyroxine has a profound influence upon the metabolism of all the cells of the body; although after its administration in even a small dose, the stimulating effect is prolonged, yet the continual loss of iodine from the body indicates that the thyroxine is continually destroyed, with the result that a steady supply of iodine is necessary to maintain a constant formation of the hormone. In the absence of a sufficient absorption of this element, the thyroid gland enlarges, and finally may fail to supply sufficient thyroxine for the needs of the body, producing a slowing of metabolism in the adult, and also, in the young, failure of growth.

Sulphur.

In contrast to iodine, animals can only utilise organic sulphur, inorganic forms being treated as waste products and excreted. Hence they are dependent upon plants or other animals for their supply of this essential element. Plants, however, can utilise sulphur and sulphates, and their addition to soils poor in sulphur increases not only the content of this element, but also the assimilation of nitrogen, indicating presumably the formation of sulphur-containing amino-acids.

Until recently, only one organic compound containing sulphur was known which is assimilable by animals, the amino-acid cystine. Natural cystine is lævo-rotatory and differs in its properties from its optical isomer and the racemic form. The cystine content of proteins, both vegetable and animal, is usually low, varying from 0·5 to 3·0 per cent, but it is still lower in gelatin and casein; wool keratin, however, contains about 13 per cent, and the protein from *Antiaris toxicaria* upwards of 25 per cent. Part of the sulphur in proteins can be split off as hydrogen sulphide by heating with alkali, suggesting that two forms of sulphur exist in the molecule, and therefore that cystine is not the only sulphur-containing amino-acid present. More recent work, however, has demonstrated that sulphur in diketo-piperazine linkage is very labile to alkali, and the two forms of sulphur disclosed by this reagent in the molecule may simply indicate cystine in diketo-piperazine and in catenary linkage respectively.

A second sulphur-containing amino-acid has been isolated from caseinogen and some other proteins in amounts of less than one-half per cent, and Barger and Coyne have recently succeeded in synthesising it and determining its constitution; it is γ-methyl thiol-α-amino-butyric acid, $CH_3 . S . CH_2 . CH_2 . CH(NH_2) . COOH$, and has been called 'methionine' (G. Barger and F. P. Coyne, *Biochem. Jour.*, vol. 22, p. 1417; 1928). The

starting-point in the synthesis was β-methylthiol-propaldehydeacetal formed from methylmercaptan and β-chloropropaldehydeacetal; from it the aldehyde was obtained and then γ-methylthiol-α-aminobutyronitrile, from which the amino-acid was easily formed.

The sulphur-containing compounds occurring in the body, for which the intake of sulphur is required, are glutathione, taurine (in taurocholic acid in the bile), chondroitin or mucoitin sulphuric acid (in mucoproteins), and sulphur-containing lipoids: whilst inorganic and ethereal sulphates occur in the urine as oxidation products of the above, with thiosulphates, thiocyanates, taurine, and cystine. In addition, oxidised sulphur is utilised for conjugation with various compounds foreign to the body tissues which might otherwise exert toxic effects.

Deficiency of cystine in the diet of a young animal is reflected in imperfect growth: thus 18 per cent of the protein phaseolin (from the kidney bean) in the diet of the young rat will not support normal growth unless 2 per cent of cystine is added. Again, adult mice will not live on diets deficient in cystine content: inorganic sulphates, sulphur, dithioglycollic and dithiopropionic acids, cysteic acid, and taurine cannot replace the cystine, but dipeptides of the amino-acid are utilised. The loss of sulphur in the urine indicates the necessity for a continuous intake of this element: mucus is also being continually lost from the body and a certain amount of taurine is excreted, although the greater part of the bile acids is reabsorbed from the gut and again excreted in the bile. Our present knowledge suggests that the necessity for a constant supply of glutathione in the cells of the body is the main factor controlling the requirement of cystine, both in maintenance and growth.

Attempts have been made to trace the paths of cystine metabolism by adding it or other sulphur compounds to the diet: by feeding compounds of cystine in which radicles have been added to the amino or sulphhydryl groups or both together, it has been shown that for oxidation to occur, it is necessary that these two groups should be free. Again, from the fact that ingested taurine is excreted unchanged, it appears that deaminisation must precede oxidation of the sulphhydryl group in normal metabolism. These processes probably occur chiefly in the liver, and the three carbon chains left after removal of the sulphur and nitrogen are either converted into protein or glucose (as in the phloridzinised dog) or oxidised completely.

The proportion of ingested cystine retained as such to that oxidised and excreted will depend on the needs of the tissues and on the form in which it is supplied. Greater retention occurs when cystine is given in a combined form, even as a dipeptide, than when administered in the free state, and it is probable that lævo-cystine is better utilised than the racemic form. In fact, the toxic influence on the kidneys of small quantities of cystine is probably due to the fact that the dextro or racemic form has been given, since larger amounts in natural combination in protein are without this effect.

The blood contains sulphur compounds on their way to and from the tissues: in man, about half the sulphur is present as sulphate, inorganic or ethereal, the other half being 'neutral' sulphur and consisting of glutathione (0·1 per cent) and ergothionine, the betaine of thiolhistidine (0·01-0·025 per cent). The physiological function of the latter compound is not known.

Taurocholic acid occurs in much higher concentration in the bile of carnivora than in that of herbivora, but during protein starvation the amount is reduced and glycocholic acid takes its place. In the dog, cystine will not increase the amount of taurocholic acid without the simultaneous administration of cholalic acid, but in the rabbit cystine alone is the limiting factor, its administration resulting in abnormally high concentrations of taurocholic acid in the bile. Free taurine is not further metabolised by the tissues, but in herbivores its administration by mouth results in an increase in the sulphate excretion, since it is decomposed by the bacteria in the large intestine.

Much work has been carried out on the detoxicating effect of oxidised sulphur compounds. The ethereal sulphate of the urine is chiefly potassium indoxyl sulphate and represents the end point of bacterial decomposition of tryptophane in the intestine: the tissues destroy the amino-acid by a different path, since it is completely burnt to its fully oxidised end products. Similarly, administered phenol is excreted in combination with sulphuric acid, but aromatic amino-acids are completely oxidised, so that phenol cannot be in their path of degradation. Certain benzene derivatives are excreted as mercapturic acids in the dog, for example, bromo- or chloro-benzene, but such synthesis probably does not occur in the pig or in man. Phenol and ortho-, meta- and parachlorphenol do not give rise to mercapturic acid formation (see T. S. Hele and co-workers: *Biochem. Jour.*, vol. 20, pp. 598 and 606; 1926: vol. 21, pp. 606, 611, and 628; 1927). When mercapturic acid formation does occur, an abundant supply of cystine is required: this is obtained by feeding the dog on a high protein diet or injecting cystine, but on a low protein diet its formation is much decreased.

Apart from the necessity for a supply of cystine for growth and maintenance, this amino-acid may have an economic importance and become the limiting factor in the suitability of a pasture for the raising of sheep for wool production, since the protein of wool contains upwards of 13 per cent cystine, whilst the food proteins probably contain only 1-2 per cent. Finally, iodine may also become the limiting factor under certain conditions, since there is evidence that thyroid feeding will improve hair growth even in under-nourished animals and at the expense of a further loss of body weight, indicating that a plentiful supply of thyroxine is necessary for hair growth as well as body growth, and that a deficient intake of iodine may decrease the production of wool even if the cystine intake is adequate.

Polyploids and Polyploidy.[1]

By C. D. DARLINGTON.

ANOTHER means of variation, closed to the ordinary diploid, is open to the polyploid. This is variation by loss. Gametes of a diploid which are not equipped with the full chromosome complement are not as a rule functional, but in a tetraploid, where every part of the hereditary material is represented twice in the gametes, loss of a chromosome or part of a chromosome does not necessarily lead to non-viability and is a possible source of a new chromosome balance, a new genetic type. This kind of change is probably responsible for a great deal of the variation in that highly variable species *Tradescantia virginiana*.

It is not surprising, therefore, that many polyploid species, both in breeding behaviour and in chromosome behaviour, resemble this second type, the type of *Primula kewensis*. The hexaploid *Prunus domestica*, having three times the chromosome number of its diploid relatives, itself usually behaves like a diploid, but when it is crossed with one of these diploid relatives the hybrid behaves like a tetraploid of the *Datura* type. Pairing takes

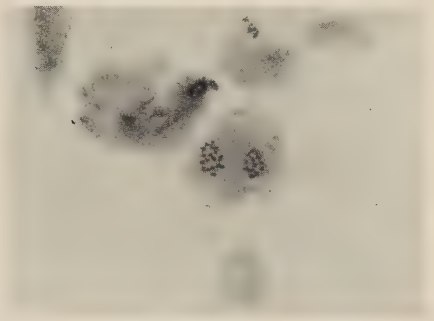


FIG. 5.—Metaphase of the second division in a pollen mother-cell of a tetraploid cherry. As a result of the formation of quadrivalents at the first division, two unequal bodies of chromosomes (13 and 19) have separated.

place not merely between corresponding chromosomes of the diploid and hexaploid, but also between corresponding chromosomes, derived each from the hexaploid, but not normally pairing. In spite of the regularity of chromosome behaviour, this analytic method of investigation is unsatisfactory from the genetical point of view, for the sets of chromosomes of the original diploid parents have probably ceased to be competent by themselves. The processes of variation found in diploids have continued in the polyploid without the same physiological restrictions. The result of splitting up the complement of a polyploid species is therefore sterility.

Hexaploid wheat or oats, when self-fertilised, breeds true in the main, but from time to time seedlings appear having the characters of related species, which have evidently remained submerged so long as the hybrid has behaved like an ordinary diploid. This segregation has been shown to follow the exceptional pairing of homologous but non-

Continued from p. 64.

identical chromosomes, presumably of specifically distinct origin. We must therefore distinguish between the *primary segregation* that results from the normal pairing in a polyploid, and the *secondary segregation* of the characters of its ultimate diploid parents, which results from the exceptional pairing of their unlike chromosomes. The behaviour in these cases is an exact parallel of that in the experimentally produced *Primula kewensis*.

When two hybrid tetraploid species such as *Triticum polonicum* and *T. durum* are crossed, complicated results are naturally to be expected from the combination of these two types of segregation. As in the *Prunus* hybrid, not two species but four are really concerned, and *a priori* we can have no reason for predicting one kind of pairing and segregation rather than another. Breeding results show that, in respect of certain chromosomes at least, there is regular pairing of the chromosomes derived from the ultimate diploid parents of each species, with the consequent segregation of their characters, and the suppression of the characters of the immediate tetraploid parents, which are never recovered in subsequent generations.

A hybrid in *Rubus* shows another complexity in segregation. Three seedlings were raised from a cross between the diploid *R. rusticanus inermis* and the tetraploid *R. thyrsiger*. Two of these were indistinguishable and, as might have been expected, closely resembled the tetraploid parent; they were triploid. The third, although obviously a hybrid, resembled the diploid parent more closely in seven well-marked characters which chiefly distinguished the two parental species. This seedling was tetraploid, and evidently the result of the union of a normal reduced male with a diploid female gamete. Thus where the female parent had made a double contribution of hereditary material, its genetical influence was increased.

This tetraploid seedling was fertile; the triploids were, as usual, sterile. In its breeding it showed two types of segregation: first a random segregation with the recovery of approximately 1 in 36 of the quadruplex recessive; secondly, the complete suppression of the characters of one parent. These results would be expected if the several chromosome types of the two species had varied independently, so that in one type there was indifferent affinity, in another a rigidly determined system of pairing. The behaviour of this cross, in both the first and second generation, affords a neat example of the application of the chromosome theory to the theory of interspecific hybridisation.

It may be worth while pointing out that, in so far as there are species in *Rubus*, this fertile seedling is a new species. Similarly, in so far as there are species in *Primula*, *P. kewensis* is a new species, and, in so far as there are species or genera in the *Cruciferæ*, the *Raphanus-Brassica* tetraploid is a new species or a new genus. Polyploidy is therefore evidently a means of species-formation. Its

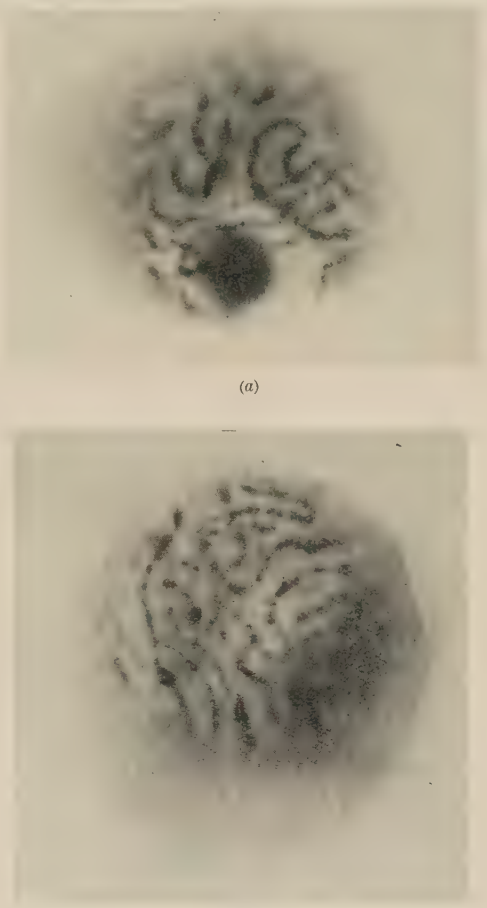
mportance in evolution is more doubtful. Poly-oids in their origin pass through a process that is rtually irreversible, and the advantages of their culiar properties are therefore to a great extent eretricious. But if polyploids are not themselves evolutionary importance the occurrence of poly-oidy is probably a symptom of evolutionary ocesses, such as hybridisation, that are of great mportance. Moreover, polyploids afford a field for e study of the hereditary material under con-tions which apply critical tests of its properties. nese must now be considered.

Since not merely the fertility of a polyploid but so the genetical behaviour in every other way epends on the pairing of its chromosomes, the nditions of this pairing are well worth our study. nese conditions are evidently not simple, for romosomes may regularly pair in certain circum-ances (as in the diploid *Primula kewensis*), but rely pair when identical mates are available. nis problem we may shelve by saying that pairing epends on 'relative affinity'. But we may also t, as in triploid *Hyacinthus* and tetraploid *atura*, the failure of association of chromosomes nown to be identical or nearly so.

This problem, evidently related to the other, is t so easily dismissed. To understand it we must amine the processes leading up to 'metaphase' the reduction division at which pairing is chiefly udied. At an early (prophase) stage in *Hyacin-us*, three or four threads, according to the mber of corresponding chromosomes of a rticular type, are seen to *pair*; that is to say, ch part of each thread takes as partner a corre-onding part of one of the other threads, and, rthermore, in doing so it acts independently of ctions higher up and lower down the thread (see g. 6). We find, with three threads, one of the ree is always unpaired, but it is a different one the three that is unpaired at different points. ith four threads interchanges of partner occur nongst them. Thus pairing depends not on any neral affinity of the chromosomes for one another, t on the capacity of the individual parts of the romosomes to pair. This seems equally clear from e results of genetical analysis of the forms of *osophila*, in which parts of chromosomes have been versed. The basis of the affinity of chromosomes ems then to be similar arrangement of their rts. A dissimilar arrangement giving a lower inity need not necessarily be correlated with netic differentiation, but it nearly always will be, it will indicate different descent.

Let us now see why these chromosomes, which obably always pair at prophase, fail to associate metaphase. In the triploid hyacinths the failure form a trivalent falls almost exclusively on romosomes of a short type, and similarly with adrivalents in the tetraploid. If the pairs formed this type of chromosome are compared with ose of the longer types, it is seen that they are atively simple. Both kinds consist of four romatids' or halves of longitudinally split romosomes associated in pairs, but in the longer romosomes these chromatids change partners, forming what are called 'chiasmata,' two, three, four, or five times. In the short chromosomes, on the other hand, there is rarely more than one chiasma.

The chiasmata are formed at random both as regards number and position, and with an average frequency proportional to the length of the chromosome. Only by the failure of a proportion of chromosomes to form any chiasmata at all can this



(*a*)

(*b*)

FIG. 6.—Conjugation of chromosomes in a triploid tulip. (*a*) Chromosomes lying parallel in threes before association. (*b*) Chromosomes associated in pairs with exchange of partners.

normal frequency be maintained in the short type, for one of the three chromosomes must be associated with the other two and have two chiasmata.

The expected proportion of failure agrees approximately with the proportion (about one-fifth) of unpaired short chromosomes found. It therefore seems probable that pairing fails merely because no chiasma is established. This implies that the relationships of the chromatids at reduction are the same as at ordinary mitosis; they are attracted in pairs. The association of the chromosomes is then the result of a failure of the pairs of chromosomes that conjugated at prophase to separate, in respect of their constituent chromatids, as they came together.

If this is generally true, then short chromosomes

newly arisen by fragmentation should fail to pair regularly, and this is so wherever it has been studied, as in *Secale*, *Zea*, and *Tradescantia*. Such variation in pairing is analogous to that found in hybrids and polyploids, for in all these types the length of the chromosome pairing at prophase is reduced as compared with that in the non-hybrid diploid. It may be reduced so that in a proportion of cases chiasma-formation, and therefore pairing, fails altogether. From the opposite point of view we may say that the mechanism of reduction is fitted to give a regular segregation of chromosomes of the normal types in a non-hybrid diploid.

It would be possible for dissimilar chromosomes to pair along a sufficient length to establish a single chiasma, in the absence of competition, but with competition in a polyploid, clearly a chiasma will be most likely to be formed between the pair which is capable of association through the greater length. Differential affinity can therefore be regarded as a measure of linear identity. In this way the behaviour of the chromosomes, derived from different species, which rarely pair in tetraploid *Primula kewensis* or hexaploid *Prunus domestica*, yet always pair in the diploid *Primula* or the tetraploid *Prunus* hybrid, is intelligible in more or less physical terms.

We have emphasised what may be called the mechanical conditions which determine the origin and variation of polyploids. This is because the physiological conditions are already widely recognised, and are not specific to polyploids, but in the study of polyploids the two types of restriction on the origin of new forms are equally evident, and it is impossible to show that one is more important than the other. Each has a final effect, and nowhere yet has any clear relation been shown between them.

This sketch of certain features of their behaviour should show that the investigation of polyploids is of importance, not merely in determining their own peculiar properties of inheritance and variation, but also in making out principles of behaviour that are equally important in the diploid organism.

Giant Aeroplanes and their Design.

THE giant aeroplane has always influenced the mind of the engineer as well as of the layman in a manner altogether out of any proportion to its practicability. Like all other structures, animal or mechanical, it is subject to the inexorable law of Nature known to engineers as the 'law of the cube'. For an established design of aeroplane with materials of unchanged quality, the law of the cube is not seriously disputed. If the proportion of useful load is plotted against surface and engine power, a well-defined family of closed isobars is obtained shrinking to a conjugate point of maximum useful load. For a braced biplane of wood with a factor of safety of 4 to 5, five tons total was a reasonable limit in pre-War days. An accumulation of detail improvements has put up this figure to seven or eight tons total weight, the disposable weight, including fuel, being about two-fifths of the total weight, and the paying load for five or six hours' flight being roughly one-fifth.

If instead of considering the useful load by itself it is considered as a fraction of the total weight, a very different conclusion is reached. The smaller the aeroplane the greater is the proportion of useful load until the indispensable weights—pilot, instruments, etc.—become a serious proportion of the total weight. A competent judge with wide experience has given the opinion that the best size from the point of view of useful ton-miles is less than two tons total weight.

The weak point in the argument is that the estimation of structural weight and aerodynamical quality is necessarily based on the best current practice, and though it is unlikely that all the competing designers in the world have missed any serious point in the theory or practice of structural design, still the possibility remains and is the standby of those who advocate the possibility and indeed the superiority of giant aeroplanes.

The history of these efforts is not encouraging. It is not necessary to refer to the positive disasters which marked the first flight of most of the early giants. Taking only recent designs, although a number of ten to fifteen ton aeroplanes and flying boats have flown and landed without accident, and have proved at least controllable in the air, yet there has not been put forward the slightest evidence that the performance as measured by useful ton-miles has increased, and much evidence that the relative performance, useful ton-miles per ton of total weight, has fallen off badly, in the very way predicted by the law of the cube.

The latest effort to break away from the natural limitation of size is that of the well-known German designer, Dornier. In a recent paper to the Royal Aeronautical Society, he announced the construction of a giant flying boat with twelve engines, distributed along the span, in pairs, with a total power of about 5000 kw. and a total flying weight of about 50 tons. It is now announced that this real giant among flying machines has successfully arisen from and alighted on the surface of Lake Constance.

The distribution of weights along the wing is an old device for reducing the stresses on the wings in steady flight. As in all other cases of design where a compromise has to be made between conflicting requirements, this is offset by a corresponding disadvantage that the stresses in a landing, especially in an unequal landing, are increased. The wing structure is thus exposed to reversed stresses of a severe and indeterminate kind. Other serious disadvantages follow.

The device has failed in previous attempts. It is advisable to wait for authenticated test evidence before accepting the truly revolutionary forecasts made by the designer, of which the most astonishing is the increase of useful ton-miles with size without limit, not merely absolutely but in proportion to total weight.

Obituary.

MR. M. R. OLDFIELD THOMAS, F.R.S.

MICHAEL ROGERS OLDFIELD THOMAS, who died in tragic circumstances on June 16 at the age of seventy-one years, was from boyhood devoted to the study of natural history. In 1876, at the age of eighteen, he was appointed to a clerical post in the British Museum. During the two succeeding years he devoted his leisure to biological studies under Huxley at the Royal College of Science and soon proved himself to be an alert observer with most capable hands. His beautiful dissections, and the ease and speed with which he made them, soon won the admiration of his teachers; and their reports persuaded Dr. Günther, the Keeper of Zoology, to arrange for the transfer of Thomas from the clerical to the scientific staff of the Museum. Thomas used to tell an amusing story of that transfer. For some months he was aware that it was going to take place; and rumour told him that he would work in future at echinoderms. Accordingly he took up the study of echinoderms with enthusiasm. At last the great day dawned. Dr. Günther sent for him and said: "Thomas, you will do the mammals." Poor Thomas murmured something about echinoderms, but the autocrat thundered: "You *will* do the mammals." Visions of countless sheep and cattle rushed into the lad's mind and, as Thomas put it, he hated those animals from a systematic point of view for ever more.

Günther never made a wiser decision as it turned out. He was himself greatly interested in the Mammalia, and he thought that the keen, sharp-sighted boy would be just the person to help him to continue the solid contributions he was making to systematic literature on Mammalia. But the skirts of a great keeper's cloak were not ample enough to conceal for long the enthusiastic and ambitious Thomas. Günther had intended to write the Museum Catalogue of Marsupialia and Monotremata himself; but Thomas made so many discoveries and worked with such energy and painstaking thoroughness that Günther willingly relinquished the task to him. In 1888 the Catalogue was published, and it remains to this day the solid foundation of all modern systematic work on the group.

Two events which profoundly influenced Thomas's subsequent career happened in or about 1890. Before that time mammal collections consisted chiefly of spirit specimens and of specimens stuffed with their skulls inside. The Biological Survey of the United States Department of Agriculture had just been established under the leadership of Dr. C. Hart Merriam, and the first reports under the serial title "North American Fauna" were just beginning to appear. Attracted by these, Thomas found that Merriam was working with long series of carefully prepared dried skins, each skin accompanied by its own cleaned skull. Correspondence followed and Thomas decided to give the new methods a trial. In the course of the next few years he perfected them. Leaving North America in the competent hands of the Americans, Thomas resolved that the British Museum should attempt a survey of the mammals of the rest of the world—a big task for one institution with limited means and for one rather frail man to undertake.

After his marriage to Mary Kane, daughter of Sir Andrew Clark, in 1890, Thomas was in possession of considerable means. His wife, interested in natural history herself and devoted to all that concerned her husband, readily agreed to the use of as much as could be spared from their joint purse for the purpose of financing collectors of mammals in various parts of the world. They went, too, on collecting trips together into various parts of western Europe and to South America. Quickly Thomas gathered round him a band of volunteer workers in the Museum; and by hard work and perseverance he gained the ears and the purses of many wealthy people who were glad to benefit the national collections and advance the cause of science.

Gifted with an extremely practical mind, Thomas was able to cut out all unessentials; in each problem that came to him for solution he saw at once the point and the shortest way to it. He worked with amazing rapidity, jumping from one matter to another without hesitation or confusion of ideas, and he never forgot anything of importance. A continuous stream of papers flowed from his pen in the *Annals and Magazine of Natural History* from 1880 down to the present year, with many contributions to the *Proceedings of the Zoological Society* and the *Journal of the Bombay Natural History Society*. Meeting that keen naturalist the late R. C. Wroughton in 1909, they developed together the well-known Mammal Survey of India, by which huge collections of Indian mammals have been brought together and worked out, resulting in a vastly extended knowledge of this part of the zoology of India and the adjacent countries.

In all, Thomas described more than 2000 species and defined more than 200 genera of mammals. His papers are models of terse description with nothing superfluous anywhere. Indeed, over and over again he might have said a little more with advantage; but there was always another job waiting to be done and he had said enough for the present purpose. Always busy and somewhat difficult to approach, people who knew him only by his scientific writings regarded Thomas merely as a narrow systematist and a "mere museum naturalist". No greater error was ever made; he was at heart a field naturalist, and on his various journeys made important collections of flies and myriopods in addition to his mammals. But with a big task before him, he deliberately restrained his natural inclinations, saw clearly what he had to do, and lived just long enough to do it. His work has built the unrivalled national collection of mammals and the vast literature relating to it.

In order to accomplish his life's work, Thomas refused to entertain any thought of official promotion. Elected an F.R.S. in 1901, he served on the council of the Royal Society, and for many years

on the council of the Zoological Society of London. After his official retirement from the Museum in 1923, he continued his old work as though nothing had happened. The death of his wife in May 1928 was a severe blow from which he never recovered.

M. A. C. H.

PROF. HENRI ANDOYER.

BY the death on June 12 of Marie Henri Andoyer at the age of sixty-six years, French science has lost a distinguished member of that characteristic school of mathematical astronomers of which such men as Tisserand and Radau were eminent examples and Henri Poincaré the most brilliant ornament. In Andoyer a rare combination of qualities was united. To his knowledge and ability as a mathematician and his acquaintance with the technical side of practical astronomy he joined a skill and a passion for numerical calculation which recalls the kindred taste of J. C. Adams in England. He was at the same time a gifted teacher, with an enthusiasm and critical sense which made his exposition equally attractive in the shape of lectures or in published form.

Andoyer was born at Paris on Oct. 1, 1862, and entered the École Normale Supérieure in 1881, devoting himself to the study of pure mathematics. The years 1885–92 were spent at Toulouse, where Andoyer was attached to the Observatory but more actively engaged as professor in the faculty of science. As astronomer, however, he took part in organising the work of the Astrographic Chart, and attended the early conferences on the scheme at Paris. In 1892, before this work had advanced beyond the preliminary stages at Toulouse, Andoyer was recalled to Paris to deliver a course of lectures on mathematical astronomy and celestial mechanics and to share in the teaching of mathematics in the Faculty of Science. To this period belongs his "Leçons sur la théorie des formes et la géometrie analytique supérieure", together with a number of more elementary text-books and some original papers, all devoted to pure mathematics. It was thus comparatively late in life that his devotion to mathematical astronomy asserted itself as an absorbing study, and even after 1903, when he was appointed professor of astronomy at the Sorbonne, his interests were not always confined in any narrow sense to the subject of his chair. The germ to be seen so early as 1887 in a paper on intermediary orbits, inspired by the work of Gyldèn, was a little slow in bearing fruit.

In 1910, Andoyer succeeded Bouquet de la Grye as a member of the Bureau des Longitudes, and on the death of Radau in the closing days of 1911 followed him as editor of the *Connaissance des Temps*. The annual ephemeris has appeared under his direction from the year 1914 onwards, and has fully maintained the high reputation earned for it under his predecessors.

Two works of permanent value embody the substance of Andoyer's teaching. One, "Cours d'astronomie", comprises a first volume on theoretical astronomy, which reached its third edition in 1923, and a second on practical astronomy, of which the second edition, in collaboration with A. Lambert, appeared in 1924. The other, "Cours de mécanique céleste", in which stress is laid on the computational side of this intricate subject, was published in two volumes (1923 and 1926).

The theory of the moon's motion, after the work of Delaunay and Radau on one hand, and of Hill and E. W. Brown on the other, presents a field offering little scope for easy or striking achievements of a novel kind. But it was to this difficult and in appearance fully explored problem that Andoyer turned repeatedly with complete knowledge of what had been done by others. It is the subject of his last considerable work, "Sur la théorie analytique du mouvement de la lune", the culmination of a series of critical studies in a branch of astronomy for which he was exceptionally qualified by natural gifts.

Andoyer's passion for numerical calculation found scope in the recomputation of fundamental logarithmic and trigonometrical tables. Executed single-handed and with remarkable rapidity, equal evidence of unfailing industry and quite extraordinary skill, these tables were published between 1911 and 1918. It is likely that they will not be superseded by any later work of the same kind, at any rate performed in the same fashion.

Andoyer was elected an associate of the Royal Astronomical Society in 1914 and became a member of the Paris Academy of Sciences in 1919. He was Officier of the Legion of Honour. Of a modest and simple disposition, he will be mourned by a circle of colleagues, and his death removes from the ranks of astronomy a gifted and indefatigable worker not easily replaced.

H. C. P.

WE regret to announce the following deaths:

Mr. W. S. Andrews, at one time associated with Edison in electrical developments and distinguished for his work on fluorescence and phosphorescence and selenium cells, on July 1, aged eighty-one years.

Dr. Charles F. Brush, of Cleveland, Ohio, the inventor of the electric arc light known by his name, on June 15, aged eighty years.

Prof. Wilhelm Ellenberger, formerly rector and director of the physiological and histological institute and of the physiological chemistry research station of the Veterinary Highschool, Dresden.

Lieut.-Colonel George Henderson, formerly of the Indian Medical Service and for a time Director of the Royal Botanical Gardens and professor of botany in the University of Calcutta, on June 24, aged ninety-two years.

Major C. V. Hodgson, hydrographic and geodetic engineer and assistant chief of the division of geodesy, U.S. Coast and Geodetic Survey, who had taken part in many surveying expeditions to the waters of Alaska and the Philippine Islands, and was known chiefly for his work on geodetic astronomy, on May 19, aged forty-nine years.

Mr. G. R. Kaye, formerly of the Indian Education Department, author of some well-known works on Indian astronomy.

M. Léon Lindet, member of the Section of Rural Economy of the Paris Academy of Sciences, known for his work on the physiology of plant and animal foodstuffs, on June 16, aged seventy-two years.

News and Views.

We have referred from time to time in these umns to the importance of scientific research in the velopment of the British Empire overseas and to work in this connexion of Mr. L. S. Amery d Mr. W. Ormsby-Gore, Secretary and Under-cretary of State for the Colonies respectively in recent Conservative Government. That there is be continuity of effort and to some extent of icy by the present Government appears probable m the speech made by Mr. J. H. Thomas in the use of Commons on July 12 last, in moving a olution, which was agreed to, "authorising the easury, on the recommendation of a Committee to appointed by the Secretary of State, to make vances, either by way of grant or by way of loan, the Governments of certain Colonies, territories der his Majesty's protection, and mandated terri-ies, for the purpose of aiding and developing riculture and industry in the Colonies or territories d thereby promoting commerce with or industry the United Kingdom". The resolution authorises annual payment of not more than one million nds, and Mr. Thomas has in mind a small but ive committee to allocate the grants. An un-pended residue in any year will not be available the succeeding year. Mr. Thomas thinks that eeding up colonial development will provide much ful work in Great Britain; indeed, the scheme is rt of his plan for dealing with unemployment nerally.

In the discussion of Mr. Thomas's resolution, Mr. nery specifically raised the question of scientific earch, health campaigns, etc., and obtained an urance from Mr. Thomas that nothing which could called 'development' would be excluded. Mr. nsby-Gore also referred to this question, and stated t research undertaken under this resolution should in relation to purely local problems or those ecting a group of colonies only and, as such, outside purview of the Empire Marketing Board. Mr. omas stated that the risk of overlapping the work the Empire Marketing Board has been foreseen, he does not anticipate difficulty from this cause. ch was said during the debate about industrial velopment and little about scientific research, which s necessary antecedent. Mr. Thomas has promised mall committee of "knowledge and experience". viously, the successful working of the scheme will pend almost entirely on the composition of this mmittee; we trust, therefore, that some members least will have "knowledge and experience" of prime necessity of scientific research in the velopment of tropical countries.

A lecture with demonstrations was given by J. C. Bose on July 9 at the India Office, the Right n. Wedgwood Benn, Secretary of State for India, ng in the chair. Sir J. C. Bose thinks that the chanism of life can best be studied in the more damental and earlier form presented in plants. s can only be realised by exceeding the range of perception of our organs of sensation by means, for example, of his 'contraction recorder' which it was stated, produces a magnification of fifty million times. Great as this is, it may be mentioned that, even before the advent of the thermionic valve, the combination of optical and electrical methods had exceeded this magnification and that optical methods of recording exhibit superiority over mechanical means from the point of view of freedom from inertia, time-lag, and speed as well as magnification. An experiment was performed which included the chairman and the stem of a lupin plant in series with the secondary of a small induction coil; the interrupted primary current was gradually increased and the plant stem was found to bend before the human subject objected to the strength of the electrical stimulus. This does not necessarily show, however, that the plant was more sensitive than the human being; whereas the plant early exhibited locally unequal degrees of mechanical contraction as a result of electrolytic changes at the site of passage of an electric current, the human being experienced a sensation which, in the usually accepted terminology, involves a change in consciousness. A valve voltmeter or a thermo-vacuo junction included in the same circuit would have proved more 'sensitive' than either plant or animal.

It is perhaps well to make it quite clear that the term sensitivity has quite a different connotation in physiology from that which it has in physics; it would thus appear that the so-called sensitivity of plants, for example, to light, gravity, and electrical, mechanical, and chemical stimuli, is of the purely physical type and must obviously remain so as long as we regard consciousness as the discriminating attribute between animal and plant. Other experiments of Sir J. C. Bose have led him to assign to plants nervous and cardio-vascular systems. One such experiment was demonstrated: the stem of a drooping lupin leaf was placed in a tube of water and camphor was added to the latter. The erection of the leaf in a jerky manner (responding just like a crinkled balloon to steady inflation) was presumed as evidence of the existence of a pulsatile organ in the plant causing the ascent of sap. A consideration of the purely physical action of camphor, for example, on surface tension would merit attention in this connexion. Seeing Sir J. C. Bose's demonstrations, it is impossible to question the occurrence of the phenomena he describes; but animal physiologists will not readily accept his interpretations. Sir J. C. Bose also showed pictures of the Bose Research Institute at Calcutta. It is to the co-operation of workers trained in this and similar institutes with the intellect of Britain that Sir J. C. Bose looks for the solution of the common difficulties of the two nations.

The Devonport Pathological Laboratories of the Seamen's Hospital, Greenwich, together with a new Nurses' Home, were opened by their Royal Highnesses the Duke and Duchess of York on July 15. The

laboratory building is constructed of sand-faced red brick and stone from designs by Sir Edwin Cooper, the cost being defrayed out of a fund collected by Lord Devonport. The laboratories on two floors are placed around a central entrance hall and staircase. The lower floor accommodates two staff laboratories, a large preparation room fitted with boilers, hot-air and steam sterilisers, autoclave and serum inspissator, and the office, and at either end a large room is allocated as museum and library respectively. An animal house and a workshop are located in a short southern wing, and mortuary (with cold storage), post-mortem room, and class-room for operative surgery in a corresponding northern wing. The upper floor accommodates two staff laboratories with rooms for assistants, a biochemical laboratory with balance and dark rooms attached, and several smaller rooms for research workers. The flooring throughout is of wood block, except in the entrance hall; the working benches are of teak, and are supplied with water, gas, and electric current (light and power), and internal and Post Office telephones are installed in each laboratory. The equipment of centrifuges, incubators, microscopes, microtomes, and glass apparatus is very complete. Heating is by hot-water radiators supplied from the boiler-house near by, in which is also a gas incinerator for destruction of waste and infective materials.

IT is reported in the *Times* of July 15 that a charter for the constitution of trustees to administer the National Radium Fund and to provide for the duties of the National Radium Commission, has been granted by the Privy Council. The charter makes provision for the election of trustees of the radium and for an executive body to be known as the National Radium Commission. The trustees will hold all the moneys and buy therewith and hold radium for use by this Commission. The duties of the Commission will be to deal with the distribution and use of all radium held by the trustees, having regard to the advancement of knowledge and economy of use; and to approve plans for the use of radium for medical treatment and research. It is thus seen that the duties of the Commission are wide ones and the granting of this charter marks a very important phase in the development of radiology in Great Britain.

UNDER the auspices of the Beaux Arts of France, and with the concession granted by the French Republic to dig at Combe-Capelle in a remarkable Moustierian site, Dordogne District, the Canadian School of Prehistory has just opened its season for 1929, headquarters being at the classic site of Les Eyzies de Tayac. The season of 1928 proved so fruitful in results that the School was enabled to install in several museums of the universities of Canada collections illustrating the activities and industries of early man from the Ipswichian (pre-Chellean) to the Robenhausian Period. Of the problems remaining to be solved in the Moustierian Period, the Canadian School was fortunate enough to obtain evidence in four distinct zones below the "Vieux Moustierien" of the classic section of Le Moustier, which add new information to the facts already known with respect to Moustierian man (Neanderthal). After careful inspection of all the collections made by the Canadian School in France by the Administrator of the Beaux Arts in the Dordogne District (M. Peyrony), the Laboratory of Geology and Palæontology at Ottawa, the School's headquarters in Canada, was further replenished with about 8000 specimens for distribution.

THE School in 1928 visited many of the sites of the Dordogne, Charente, and Pyrenees sections of France, under the guidance of M. Peyrony, Count Begouen, Dr. Henri Martin, Abbé Breuil, and others. By special invitation to visit and explore the Neolithic site of Ryckholt (Ste. Gertrude) in the highlands of Holland, the Canadian School was able to add an excellent series of specimens to its collections for Canadian universities. A movement is now on foot in Canada to incorporate by Act of Parliament the Canadian School of Prehistory, with the object of backing up the work that has been done and is being done by the School in France. The movement is led by Dr. E. R. Cameron, K.C., of the Supreme Court, and a number of leading archæologists and ethnologists of the Dominion. One of its chief objects will be the investigation of prehistoric sites in the northern districts of Canada where the Eskimos and the reindeer, with the musk-oxen, great stag, and bisons, are found to-day, all well-known types of life which once lived in south-western France in Magdalenian times. The Canadian School welcomes visitors to the site at Combe-Capelle where the excavations are going on, and especially those from the British Isles and other parts of the Empire interested in prehistory.

THERE is a demand for radio telephone sets by owners who can pilot their own aeroplanes. The sets used by commercial aircraft are much too heavy for light aeroplanes. The transmitter must have a range of at least fifty miles when communicating with the ordinary aerodrome ground station and a hundred miles when communicating with a large station like the one at Croydon. The Marconi Co. has now designed a set to meet these requirements. It combines a telephone transmitter and receiver in a compact wooden box the dimensions of which are only 16 in. by 9 in. by 7 in. Its weight, including that of the wind-driven generator, accumulator, aerial and connecting leads, is only 60 lb. The set has been designed for the transmission of telephony only. Pilots have quite enough to do in flying their machines and watching their instruments without the added labour of interpreting telegraph signals in the Morse code. The set may be installed for operation by the passenger or it may be fitted in any convenient part of the aeroplane and operated by the pilot through a 'remote control'. In the latter case there is only a one-handle manipulation. Seeing that private air cruising on business and pleasure is rapidly becoming popular, we welcome this device. Advice regarding the state of the weather and the conditions at the various aerodromes will now be available to light aeroplane tourists. In addition, they will now have a valuable means of position finding when flying over parts of the Continent and other places where there are aerodrome

round stations fitted with direction finders. We hope at the international regulations enforcing adequate dio facilities on commercial aircraft will now be forced on privately owned aeroplanes.

IN August next the *Discovery* will set out once gain on a voyage of exploration and scientific discovery to the Antarctic continent. The enterprise, hich is under the leadership of Sir Douglas Mawson, being sponsored by the British, Australian, and ew Zealand Governments, and considerable assistnce in money and kind has been given by private dividuals and firms, both in England and Australia. r. MacRobertson, a wealthy manufacturer in Melourne, has contributed £10,000 to the funds of e Expedition, and several other private subscribers e assisting, but no general appeal to the public is eing made for funds. The *Discovery* is now being verhauled at the West India Docks, and is being ted with all the essential scientific gear that the rthcoming expedition makes necessary. Capt. J. K. avis, who has been lent by the Government of the ommonwealth of Australia, has been appointed aster, and will also act as second in command of the pedition. He was associated with Sir Douglas awson in a similar capacity on the pre-War Australian Antarctic Expedition and has special and tensive experience in the Antarctic coastal and pack- waters. The scientific personnel and crew will umber about forty. The vessel will carry an aeroane with floats for rising from and alighting on the a (where open water makes this possible), and ternatively will use a ski undercarriage for use on e or snow. The aeroplane will be used for scouting, r photographing the coast-line, and for general urposes as a 'long arm' of the expedition. The ip will be equipped with powerful deep trawling ar and with echo-sounding apparatus. Both longave and short-wave wireless equipment will be rried. The expedition will carry out hydrographic rvey work, and will study meteorological conions with the view of discovering any relationship tween those conditions and the climate and weather Australia. It will also carry out investigations of e fauna, notably whales and seals, of the region plored.

DR. WILLIAM HUME-ROTHERY has been elected to e research fellowship in metallurgy of the Armourers d Brasiers' Company in succession to Dr. Constance Tipper.

THE Autumn Lecture of the Institute of Metals ll be delivered during the forthcoming Düsseldorf eeting on Sept. 5 by Mr. A. G. C. Gwyer, who will eak in German on aluminium and its alloys.

THE following appointments have recently been ade to the Imperial Bureau of Soil Science: Scientific sistant, Mr. A. J. Lloyd Lawrence; assistant for anslations, Miss H. Sherbatoff.

MR. H. T. TIZARD, permanent secretary of the epartment of Scientific and Industrial Research, s been appointed rector of the Imperial College of Science and Technology as from the beginning of September in succession to Sir Thomas Holland.

WE learn from Miss C. J. Vivian, 4 Dolcoath Road, Camborne, Cornwall, that a vigorous tremor was experienced at about 7 P.M. on July 7 in various parts of Camborne. In a church at Penponds, near Camborne, the vibration was so intense that the rafters creaked audibly. Old tin-mine workings undermine a part of the town, but a subsidence of the soil due to this could scarcely cover the district affected.

THE following have been elected officers for the session 1929–30 of the British Institute of Radiology incorporated with the Röntgen Society—*President:* Mr. C. Thurstan Holland; *Past Presidents:* Sir Humphry Rolleston and Dr. G. W. C. Kaye; *Vice-presidents:* Sir William Bragg, Mr. L. A. Rowden, and Major C. E. S. Phillips; *Honorary Treasurer:* Mr. D. B. McGrigor; *Honorary Secretaries:* Dr. Stanley Melville and Dr. G. Shearer; *Honorary Editors:* Dr. G. W. C. Kaye and Mr. R. J. Reynolds.

THE annual report and accounts for 1928 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, has been issued. The Institute was founded primarily to carry out research work in the prevention and treatment of tropical diseases, and is supported entirely by voluntary contributions. An account is given of the visit of Sir Malcolm Watson and Major Stevens to India and Ceylon for the purpose of advisory and propaganda work on malaria, and of the research work carried out in the Institute.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Engineering Department of the Leicester College of Technology—The Registrar, College of Technology, Leicester (July 22). An assistant county agricultural organiser under the Hampshire Agricultural Education Committee—The Agricultural Organiser, 82 High Street, Winchester (July 24). A head of the Mechanical Engineering Department of Robert Gordon's College, Aberdeen—The Secretary and Registrar, Robert Gordon's College, Aberdeen (July 29). An assistant lecturer in physics in the University of Leeds—The Registrar, The University, Leeds (July 29). A lecturer in pharmacy in the Department of Chemistry of the Witwatersrand Technical Institute—Messrs. Chalmers and Guthrie, Ltd., 9 Idol Lane, E.C.3 (July 31). An assistant lecturer in the Department of Chemistry of the University of Birmingham—The Secretary, The University of Birmingham (July 31). A superintendent of the Burma Civil Veterinary Department—Secretary to the High Commissioner for India (General Department), 42 Grosvenor Gardens, S.W.1 (Aug. 4). A lecturer in physiology in the University of Birmingham—The Secretary, The University, Birmingham (Aug. 5). A demonstrator in civil and mechanical engineering in the Department of Engineering of the University of Leeds—The Registrar, The University, Leeds (Aug. 5). Two timber assistants for the Utilization Forest Circle, Commercial Concern, Burma—The Secretary to the

High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Aug. 10). A lecturer in mineralogy and petrology in the University of Reading—The Vice-Chancellor, The University, Reading (Aug. 14). An assistant plant pathologist under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (Aug. 15). An assistant superintendent in the Archæological Survey Department of the Government of India—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Aug. 17). A professor of geology and mineralogy in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Aug. 31). A research assistant in the Colour Chemistry and Dyeing Department of the University of Leeds—The Registrar, The University, Leeds (Sept. 2). A professor of clinical pathology in the Egyptian University, Cairo—The Dean, Faculty of Medicine, Egyptian University, Cairo (Sept. 15). An assistantship in natural history—The Secretary, University College, Galway (Sept. 21). An assistant director of the Technological Library of the Indian Central Cotton Committee, Bombay—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 29). Part-time lecturers in market research and sales management at the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1. A head of the pathological division of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2-4 Idol Lane, Eastcheap, E.C.3. A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A full-time chief instructor of the Printing Department of the North-Western Polytechnic, Prince of Wales Road, Kentish Town—The Secretary, North-Western Polytechnic, Prince of Wales Road, N.W.5. An assistant master to teach mathematics in the Junior Technical School for Boys of the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. A teacher of telephony in evening classes at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. A chief officer for the Imperial Agricultural Bureau for Plant Genetics: Herbage Plants—Prof. R. G. Stapledon, Agricultural Buildings, Aberystwyth.

Our Astronomical Column.

July and August Meteors.—Mr. W. F. Denning writes: "The season for meteoric abundance has now opened and a large number of showers are visible, including the early phase of the great Perseid display. The latter appears to be visible during the whole of July and August with a maximum on Aug. 11 or 12. Probably the morning of the latter is the period when most meteors will be visible. The present year seems likely to be favourable for the occurrence of many meteors, for an abundant maximum of 250 per hour for one observer was counted in 1921 on the early morning of Aug. 12. The earth will occupy very nearly the same position in its orbit on the morning of Aug. 12 next, and the shower may be repeated if the density of the part of the stream encountered is about equal to that through which the earth passed eight years ago. This may be doubted, however, though there are slight evidences of an eight-year period in the character of the display and observations may prove specially interesting. The Capricornids (July 19–Aug. 6) with radiant at 304° – 11°, and the Aquarids (July 24–31) radiant 338° – 11°, usually form two of the principal displays of the July–August period; but there are some hundreds of others exhibiting various degrees of strength, though the majority are very attenuated and are only to be recognised by long and accurate observation."

Ancient Greek Astronomy.—M. E. M. Antoniadi contributes an article to *L'Astronomie* for May in which he points out that several of the philosophers of ancient Greece anticipated the conception of universal gravitation. Anaxagoras, Plato, Aristotle, and others perceived that massive bodies exercised a force directed towards their centres. Aristotle ascribed the tides to the action of the sun. Anaxagoras and Empedocles recognised that the centrifugal tendency of a revolving body, such as the moon, enabled it to circulate round a central orb without falling into it. While these conceptions were quite sound, it does not appear that they were tested numerically with the same rigour as was done by more modern philosophers. Newton deduced from Kepler's laws that the sun exerts an attractive force on the planets varying as the inverse square of the distance. He did not announce his law of universal gravitation, however, until he had demonstrated that the fall of the moon towards the earth in a second was to the fall of a body at the earth's surface in the ratio of inverse squares of the distance from the earth's centre. He also demonstrated that a sphere attracts external bodies as though concentrated at its centre. Hence while we recognise the merits of the ancient philosophers, we cannot put them on the same level as Newton.

Measures of the Brightness of Earth-shine.—Prof. H. N. Russell in the *Scientific American* for July gives an account of the measures of the intensity of earth-shine on the moon made by M. Danjon at Strasbourg. He used an ingenious photometer of his own design in which the light of the sunlit lunar crescent was admitted to one section of the objective, weakened by reflection from plane unsilvered glass surfaces, and then compared with the earth-shine admitted into another section of the objective. He found that when the moon is 30° from the sun the earth-shine is $\frac{1}{1000}$ of the intensity of an equal portion of the sunlit crescent; at 90° from the sun the ratio is less than $\frac{1}{10000}$; at 120° from the sun it is $\frac{1}{40000}$. It cannot be followed further than this. The experiments also showed that the earth-shine was bluer than the reflected sunlight; they indicated that the earth is a less rough reflector than the moon, which is reasonable since much of the earth's light would be that reflected from vapours in its atmosphere. The resulting albedo of the earth is about 29, perfect whiteness being represented by 100. The figure is lower than previous estimates, which have been in the neighbourhood of 50. It is concluded that the full earth would give the moon $\frac{1}{10000}$ of the light of the sun, or more than 40 times as much as the full moon gives us. Allowing for the difference of areas, the albedo of the moon is $\frac{1}{3}$ of that of the earth, or about 10.

Research Items.

The Spirit Cult in Hayti.—The spirit cult of Hayti, ore popularly known as ' voodoo ', is the subject of communication by Dr. Elsie Clews Parsons in the *ournal de la Société des Américanistes de Paris*, .S. t. 20. The spirit cult has hitherto been unde-ribed, owing to the attention given to one of its puted features, namely, ritual cannibalism, the folk-re of which is widespread among foreigners. If uman sacrifices occur or have occurred, it is in con-xion with the ' taureau criminel', the criminal bull, ie of the *loi* or spirits, of which there are a large umber, both Catholic and African. The cult makes distinction between patron saint and West Coast tish, and may be described as the theory and practice possession by spirits. Every *loi* has his or her aits, an appetite for this or that offering ; some like *fia* (rum), others lean to a taste in dress or colour, a rticular day of the week, a particular way of taking ssession, and so forth. For example, *Loi Gédé* talks rough his nose when he takes possession of anyone ; eats only cassaba, pepper and herring ; he is a master the cemetery. *Loi Exili* likes handkerchiefs and ce clothes ; they must be red ; in her food perfume ust be put, and her favours are for men only, and thing for girls ; she is identified with a Catholic int who carres a dagger in the hand. People who t *Loi Coulève* (snake spirit) walk on their bellies. ie snake is small in the day-time but at night it comes so big as to weigh down the branches of trees. visits houses, and people do not kill it. The *loi* may cherished by anyone and may take possession of yone, or it may have been inherited within the mily so far back as the old people who were born in inea. Maintaining the shrine of the *loi* or making oper food offerings are important ways of holding eir favour. The ceremonial cult of the spirit is served in *Mangé loi* and *dansé loi*, spirit feasts and irit dances, in which some, or at times all, partici-nts are possessed. Secrecy attaches to them to a eater or less degree according to the disposition of e local constabulary.

Way-finding of Birds.—The factors concerned in the igration of birds appear to be manifold and not sily disentangled, but it is generally held that the pulse to migration is associated with the develop-ent of the sex organs. One of the most extraordinary cts of annual bird movements, conclusively proved the method of ringing, is the return of spring grants to the locality and even to the exact place which they were born, and the question arises ether this orientation is connected in any way with e development of the sex glands. A problem, allied t not identical, has been tested by G. J. van Oordt d C. J. A. C. Bol (*Biolog. Centralbl.*, Bd. 49, 1929, 173). Carrier-pigeons possess an exceptionally rong ' bump of locality ', and if this power is associ-ed with the sex glands, the influence of castration ould be apparent. The result was negative : the ly conclusion to be drawn from the experiments s that the sex hormones had no influence whatever the way-finding of carrier-pigeons. This result has, course, no bearing upon the origin, the significance, the purpose of bird orientation, but it must be garded as a caution against premature acceptance of e suggestion that sex-hormones play a part in the rection impulse of wild migratory birds.

Aquatic Caterpillars.—H. S. Pruthi (*Records Indian us.*, vol. 30, pt. 3, 1928) describes the aquatic larva d pupa of *Aulacodes peribocalis*. He observed the terpillars in the Nerbudda river in November-December 1927 wherever the water was shallow and the current rapid. They spin their silky shelters, irregular in outline, in the crevices of rough stones. The shelter, which lodges only one caterpillar, is loosely attached to the substratum, leaving numerous openings by which water can enter or leave it, so that there is a free circulation of water round the caterpillar. The caterpillar does not appear normally to leave its shelter, and there seems to be no reason why it should, for there is always around it, within the shelter, an ample supply of fresh water laden with food materials—the larva probably feeds on minute pieces of alga. Its mouth-parts are like those of terrestrial caterpillars. Although the caterpillar is aquatic it cannot swim ; if its shelter is torn away the caterpillar creeps towards the under sides of stones. The caterpillar is provided with eleven pairs of well-developed gills borne by the second and third thoracic and the nine abdominal segments, but it can live for four days after being taken out of the water. Spiracles are present, but their openings appear to be closed and the lumen of the tracheæ connecting them to the lateral tracheal trunks is more or less obliterated. When the larva is full grown, it makes under its shelter a tough and complex dome-shaped cocoon in which the pupal stage is passed. The central cavity of the cocoon communicates with the exterior by a very narrow crescent-shaped slit towards which the head of the pupa points. The moth emerges through this opening.

Brooks's Law.—Robert Gurney (*Internat. Rev. d. ges. Hydrobiol.*, Bd. 21, 1928) has examined a number of growth stages of Copepoda with the view of testing the validity of ' Brooks's Law ' propounded by Fowler (1909) as follows—" during early growth, each stage increases at each moult by a fixed percentage of its length which is approximately constant for the species and sex". Both Fowler, working on marine Ostracoda, and Sewell, on the Copepoda of the Bay of Bengal, found that in some cases there were two adult forms in each sex distinguished by size, and in one case the two forms of the adult male differed also in some structural features so much that they would have been admitted as distinct species if they had been taken separately. The author has investigated fresh-water plankton, in which as a rule only one species of Calanoid occurs, as being more favourable material than marine plankton containing a number of species. He gives details of growth factors in half a dozen species, and his general conclusion is that ' Brooks's Law ' as stated by Fowler cannot be upheld but that the subject is worthy of more attention. Within rather wide limits there probably is a specific growth factor, but there is much individual variation, and the factor changes from moult to moult in most cases. The presence at the same time of large and small forms of the adult, according to the view of Fowler and Sewell an example of dimorphism within a single race, is capable of other explanations. The author finds it difficult to escape any other explanation than that there is a moult in a small proportion of the adults.

Control of the Codling Moth.—We learn from a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., that an experiment is under way to attempt the control of the codling moth in the walnut groves of California by biological means. Advantage is being taken of the fecundity of a minute chalcid egg-parasite by adopting mass-rearing and liberation of the latter. The parasite

(*Trichogramma minutum*) is known to attack a great variety of insect eggs, and those of the grain moth have proved well suited for the experiment. It is stated that, in a building with a floor space of only 25 ft. × 36 ft., it is now possible to rear one million *Trichogramma* per day, the whole technique being a matter of skilful standardised routine. Packages containing 100,000 parasitised eggs of the grain moth occupy a very small space, and are easily sent by mail to growers troubled with codling moth. The parasites which emerge from these eggs are liberated in the walnut groves, and soon commence seeking out codling moth eggs, which are at hand in abundance. It is hoped that by materially raising the *Trichogramma* population in given districts, wholesale destruction of codling moth eggs will result, with a consequent reduction of the injuries wrought by this insect.

Light Periodicity and Plant Growth.—A further study of the importance of light duration as a factor in plant growth has been made by G. Reddington (*Trans. Roy. Soc. Edin.*, **56**, 247-272; 1929), using throughout specified conditions of electric lighting. A large number of species of plants were examined and all, except beech seedlings, grew *initially* best in continuous light but *finally* best in 16 or 8 hours of light per day. The results are explained on the supposition that carbohydrate supply is primarily the limiting factor in growth, but that, where continuous light is used, water strain may, in the later stages, limit food and water supply to the growing points. Detailed observations are given in support of this argument.

Movements of Liquids and Gases in Trees.—The problem of the ascent of water in trees is being re-examined by D. T. MacDougall, J. B. Overton, and G. M. Smith, and they have recently reported (*Carnegie Instit. Wash.*, No. 397; 1929) data as to the movements of water and gases in various trees. They find great differences in the paths of movement of dye solutions injected or allowed to enter into woody stems. In some species these only move along the summer wood, in some only along the spring wood, and in others along the late autumn and early spring wood. In Monterey pine, however, the dye travels along the whole of each annual ring of wood. The evidence suggests that the non-conducting vessels are full of gas. Examination of the internal gas pressures shows them to be subject to considerable seasonal variations. Applying suction to the gas in the tree increases the tensions on adjacent water-filled manometers, but if gas pressures (of 4 atmospheres) are applied, they are registered by air manometers 2 m.-3 m. higher up the tree but not by water-filled manometers. It is therefore concluded that varying internal gas pressures have little effect on the cohesive water system.

Miocene Mollusca of Virginia and North Carolina.—Mr. W. C. Mansfield in a short paper (*Proc. U.S. Nat. Mus.*, vol. 74, art. 14) briefly outlines the different divisions of the Chesapeake group of the Miocene epoch in Virginia, and describes and illustrates on wonderfully clear plates, seven new species and five new sub-species of mollusca therefrom. We are promised further and more complete discussion of the whole in a forthcoming number of the George Washington University *Bulletin*.

Height of Mount Everest.—A note on this subject appears in the General Report of the Survey of India for 1927–28. The value of 29,002 ft. was computed in 1852 from observations taken in 1849–50. The last figure is retained, not on account of its probable accuracy, but in order to avoid the suggestion of an estimate in round figures. In 1907, Sir Sidney Burrard calculated the height to be 29,141 ft. Dr. de Graaff Hunter, applying improved refraction corrections to results from different observation stations, gets a height of 29,149 ft., which has a probable error of less than 5 ft. and a possible error of less than 15 ft. This, however, is more than the true geoidal height. When the correction is applied, Mount Everest has a probable height of 29,075 ft., with a possible correction of 25 ft. either way. It is impossible at present to give the height of Mount Everest with greater accuracy.

The Upper Atmosphere.—In the issue of the *Physikalische Zeitschrift* for Mar. 1, Prof. H. Benndorf, of the University of Graz, gives an account of the methods which have been used recently to obtain a more precise knowledge of the properties of the upper atmosphere. Altitudes of 20 km. to 30 km. have been attained by pilot balloons with registering instruments, but for greater altitudes the study of the propagation of sound waves through the atmosphere has given the most trustworthy data. Prof. Benndorf considers our present knowledge justifies the following statements. Traces of atmospheric gases can be detected at altitudes of 1000 kilometres, and at such altitudes motions of these gases must be rapidly damped down owing to their high kinematical viscosity. In the northern hemisphere there is a drift of the layers between 30 km. and 80 km. altitude to the east and above that to the west. In the 'troposphere' up to 12 kilometres convection currents keep the atmosphere well mixed and the temperature decreases with altitude until 220° absolute is reached. In the 'stratosphere' above, convection is less marked and the temperature remains constant at 220° up to 30 kilometres. Between 40 km. and 60 km. a layer at about 300° absolute—a tropical temperature—exists. For greater heights no statement can be made, nor is the composition there known, but there is no doubt that the gases there are ionised, that the negative ions are electrons, and that at altitudes of 80 km. to 100 km. there exists at least one conducting layer with free electrons numbering 10^5 per c.c.

An Optical Law for Electrons.—The existence of still another analogy between electrons and waves has been indicated by E. Rupp in a recent issue (May 17) of *Die Naturwissenschaften*. When slow electrons impinge on a very thin sheet of metal, those which are not retarded are transmitted selectively, silver, for example, being very approximately two and a half times as opaque to electrons with an energy equivalent to 11 volts as it is to 16-volt electrons or 8-volt electrons. It is now found that the same selectivity is exhibited in reflection of electrons without loss of energy, silver again reflecting electrons particularly well when their energy is close to 11 electron-volts, and it would thus appear that the optical law connecting absorption and reflection is valid for electron waves. No relation has yet been traced between the wave-lengths of the electrons and the atomic constants of the metal foils, but it is suggested that absorption and reflection of the slow electrons are occasioned by the outer dispersion electrons of the metallic atoms.

Melting-point of Palladium.—A determination of the melting-point of palladium by Hoffman and Meissner in 1919 resulted in a value of 1556° C.

hich is 3° above the previously accepted tempera-re, and it is therefore interesting to note that a re-termination is described by Fairchild, Hoover, and ters in the May issue of the *Journal of Research*, pub-hed by the U.S. Bureau of Standards. The method nployed consisted in measuring the relative bright-ss of black bodies at the melting-points of gold and lladium, and calculating the upper temperature means of Wien's law, which is equivalent to anck's law for light and gives the spectral distribution radiation from a black body. The melting-point gold was taken as 1063°. The result obtained as $1553{\cdot}6 \pm 0{\cdot}5°$ C., and when all possible sources error are considered, the melting-point of pure lladium is probably $1553 \pm 2°$.

Dielectric Constant of Desiccated Oxygen.—The ange in the chemical activity of oxygen produced prolonged drying is accompanied by an increase the dielectric strength of the gas. Thus a greater otential is required to cause an electric spark to ss through the dry gas than through ordinary ygen. An investigation to determine whether this ange in properties involves a modification of the ructure of the oxygen molecule with a consequent ange in the specific inductive capacity, is described Riley in the *Journal of the Chemical Society* for ay. The method used was to compare the capacities two similar condensers of the same dimensions, one ntaining carefully dried oxygen and phosphorus ntoxide, and the other oxygen passed over calcium loride. By means of a thermionic valve apparatus e condensers were found to have the same capacity, d no change could be detected after ten months' posure of the gas to phosphorus pentoxide. Hence, e chemical activity promoted by the presence of nall traces of water does not appear to be connected ith any change in molecular structure.

Magnetic Storms and Radio Signals.—A recent *Daily cience News Bulletin*, issued by Science Service, ashington, D.C., reports that at a meeting of the merican Geophysical Union on April 23, Miss I. J. ymore announced that the Radio Laboratory De-artment of the Bureau of Standards has discovered interesting relation connecting magnetic storms and dio signals. When the radio signals from European ations are weaker than usual and the signals from arer stations in America are louder, then magnetic orms may be expected. After a magnetic storm uch stronger signals are received from distant ations. The conclusions were deduced from the cords obtained by experiments made with the long aves used for high power trans-oceanic transmission. veral days before the maximum of the terrestrial agnetic disturbance the signals were weak when ceived at Washington. The trans-oceanic signals, owever, received at Washington from Tuckerton, ew Brunswick, N.J., and Rocky Point, L.I., were cidedly stronger at periods varying from two to ur days before the magnetic disturbance.

Composition of Gum Arabic.—There are a number substances, such as pectins, plant gums, hemicellu-ses and mucilages, which appear to be formed by e influence of enzymes upon cellulose and may be rmed acid polysaccharides. Comparatively little is own concerning the structure of these substances, d an account of an investigation of the composition gum arabic in the May issue of the *Journal of the merican Chemical Society* is therefore of considerable terest. The plant gums are usually the calcium, agnesium, and potassium salts of very complex rganic acids, and arabic acid, obtained from gum rabic by hydrolysis, appears to be an aldobionic acid of formula $(C_{12}O_{20}H_{12})_n$. Among the products of further hydrolysis, rhamnose, *d*-galactose, *l*-arabinose, and *d*-glucuronic acid have been identified.

Synthesis of Chaulmoogric Acid from Hydnocarpic Acid.—Chaulmoogric and hydnocarpic acids are constituents of chaulmoogra oil, and are of great importance on account of their extensive use in leprosy therapy. Some years ago Power concluded that chaulmoogric acid is a homologue of hydnocarpic acid, and this has recently been confirmed by Stanley and Adams. They have synthesised chaulmoogric acid from hydnocarpic acid by successive conversion of the latter into the ethyl ester, the alcohol, bromide, and through hydnocarpylmalonic acid to hydnocarpylacetic acid. The latter showed no depression of the melting-point (68°) when mixed with pure natural chaulmoogric acid and had a rotation of $+61{\cdot}9°$. The amides prepared from the synthetic and natural products also had identical melting-points. This work is described in the *Journal of the American Chemical Society* for May, which also contains a paper by Hinegardner and Johnson on the preparation of chaulmoogrylresorcinol and some of its derivatives. The bactericidal properties of these compounds are being examined in the hope that they may be free from certain objectionable effects produced by prolonged use of chaulmoogric acids.

Long Period Forecasting.—A reprint has been received of a paper by E. T. Quayle on "Long Range Rainfall Forecasting from Tropical (Darwin) Air Pressures", which appeared originally last year in the *Proceedings of the Royal Society of Victoria*. The economic importance of this subject for a country with a rainfall so capricious as that of Australia is evident, and the results obtained are such as to suggest that the accuracy of forecasts of the early spring rainfall of Northern Victoria, based purely on Darwin pressure for the two winter months of June and July, renders these of genuine value. The relationship is a negative one, low tropical pressure being followed more than eight times out of ten by rainfall above the average, and it seems highly significant that the connexion is actually closer than that between synchronous pressure and rainfall for two-month periods. The relationship diminishes quickly when earlier or later periods are considered; thus between Darwin pressure for June and July and the rainfall of ten representative stations in Northern Victoria in August and September, the correlation coefficient is $-0{\cdot}79 \pm 0{\cdot}04$, while between May and June pressure and July and August rainfall the coefficient is only $-0{\cdot}65 \pm 0{\cdot}06$. For July-August pressure and September-October rainfall the coefficient is even smaller, namely $-0{\cdot}52 \pm 0{\cdot}07$. This detracts less from the value of the results than would be the case were the spring rainfall not of such particular importance in cereal production, and for the growth of the pasture. The relationship, it may be noted, is of the simple linear kind which justifies the use of the ordinary regression equation in the calculation of rainfalls for individual seasons, and offers some prospect of good results in the anticipation of the dreaded droughts. Presumably the clue to this relationship is to be found in the southward migration of the tropical low-pressure belt with the approach of the Australian summer, and it seems to imply a greater continuity in any abnormal feature of this belt than might have been expected. This aspect of the matter, interesting as it is from the theoretical side and from the possibility it holds out of unravelling the physical processes at work in the production of abnormal seasons, the author unfortunately does not follow up.

Annual Meeting of the Royal Society of Canada.

THIS meeting was held in Ottawa on May 20-22, in the Chateau Laurier. The president, Mgr. Camille Roy, Rector of Laval University, Quebec, addressed the Society on "Provincialisme intellectuel au Canada". Prof. J. C. Chamberlain, of Columbia University, gave, by invitation, the popular evening lecture on "The United States Government and International Relations". At the annual luncheon of the Society, brief addresses were given by Sir Robert Borden, the Hon. Wm. Phillips, United States Minister to Canada, the Hon. Jean Knight, Minister from France to Canada, and Sir Wm. H. Clark, British High Commissioner.

Prior to the delivery of the presidential address, the following gold medals were presented: The Flavelle Medal (science) to Prof. A. H. R. Buller, of the University of Manitoba, immediate past president, for his work on Fungi; the Lorne Pierce Medal (literature) to Mgr. Camille Roy, for his contributions to French-Canadian literature; and the Tyrrell Medal (Canadian history) to Prof. George M. Wrong, of the University of Toronto.

Thirty-one papers on historical and literary subjects were communicated in Sections I and II (French and English Literature and History).

Among the 150 papers communicated to the three scientific sections the following may be noted:

In Section III (Physics, Mathematics, Astronomy, and Chemistry) the sectional presidential address was given by Prof. Frank Allen, of the University of Manitoba, and was a summary of his twenty years' investigation of the laws underlying the response of the human nervous system to various types of stimuli. He has shown that a logarithmic law holds for such sensations as vision, taste, touch, and hearing, when the relation between intensity and frequency is measured. Weber's law has now been proved to hold for mechanical stimuli. The action of the nervous system is fundamentally the same for all types of stimuli. As a result of this series of researches, many psychological tests can now be placed on a true quantitative basis.

Drs. J. S. Plaskett and J. A. Pearce, in a paper on the rotation of the galaxy, conclude from analysis of 500 radial velocities of *B* type stars that the galactic system revolves in its own plane in a period of more than 10^8 years about a centre in the direction of Sagittarius some 30,000 light years away. Dr. C. T. Sullivan presented a simplified proof of an auxiliary theorem used in Bescovitch's solution of Kakeya's minimal problem. Dr. L. L. Dines dealt with the resultant of two power series in two variables. Drs. A. S. Eve, L. V. King, and L. Gilchrist presented papers on the practical and theoretical results of estimating the depths of an ore-body by electrical means in geophysical investigations. Dr. J. S. Foster dealt with results obtained in the study of the Stark effect in parallel and crossed magnetic and electric fields in helium. Prof. J. C. McLennan presented a large number of papers by himself and his associates on various spectroscopic investigations. The papers on the Raman effect in liquid hydrogen, liquid oxygen, and liquid nitrogen were of particular interest in that they confirmed the correctness of Dennison's view that hydrogen at low temperatures consists of two effectively distinct sets of molecules, symmetrical and anti-symmetrical.

Dr. E. F. Burton demonstrated a new and important method of measuring the moisture content in grains, woods, and tobacco. The device used is a critically adjusted oscillating system extremely sensitive to changes in conductivity caused by the presence of moisture in the materials investigated. Dr. J. A. Gray, speaking on cosmic rays, deduced from experimental results and theoretical considerations that it is not possible to account for the most penetrating type of the penetrating radiation on any hypothesis of the synthesis of atoms from protons and electrons.

Dr. O. Maass and his associates gave papers on hydrogen peroxide as an oxidising agent and as a solvent, on the liquid state as a catalyst, on the viscosity of carbon dioxide at low temperatures, and on absorption and diffusion of vapours through wood. Dr. G. S. Whitby and his collaborators dealt with colour reactions of caoutchouc and other unsaturated hydrocarbons, on polyindenes, and on various related subjects. Dr. R. H. Clark dealt with the preparation of alkyl chlorides from the corresponding alcohols, and with the oxidation of aromatic amino-groups. Drs. M. C. Boswell and R. C. McLaughlin gave the results of an investigation which suggests that the mechanism of the Deacon process is more complex than has been usually held.

In Section IV (Geology and Allied Subjects), Dr. R. C. Wallace, president of the University of Alberta, in his sectional presidential address, dealt with the educational aspects of the group of sciences covered by the section, and in particular with the place of geography in a university course. Physiographical papers were presented on the deepening of Burrard Inlet, B.C. (W. A. Johnston), the relationship of the St. Lawrence fault to the Palæozoic margin (Carl Fissler), and the mature valleys of the Labrador peninsula (H. C. Cooke). Palæontological contributions included the history of deposition in Canada in Silurian times (M. Y. Williams), an account of two new theropods from the Belly River dinosaur beds (C. M. Sternberg), and the faunas of the Triassic in the Upper Peace River area (F. H. McLearn). Studies in sedimentation were dealt with by E. M. Kindle (the inter-tidal zone of the Wash, England), and F. J. Fraser (the character of some heavy minerals in Canadian sediments). C. W. Knight presented evidence determining the age of the Nipissing diabase as pre-Cambrian. Other papers included the physiography and geology of Great Slave Lake (J. M. Bell), a new type of fibrous magnetite, and the characteristics of the olivine diabases of Keeweenawa age in the Canadian Shield (E. M. Moore), and a chemical study of the Sudbury intrusive, as evidence of differentiation in a single eruptive (T. L. Walker).

The presidential address in Section V (Biological and Medical Sciences) was given by Prof. F. J. Lewis, of the University of Alberta. Dealing with the broader aspects of plant ecology, he pointed out the importance of past investigations in New Zealand, Australia, and South Africa on various types of grasslands and the effects of burning and grazing upon them to a country like Canada in which grazing is a prominent feature of farming, and considered that study of soil moisture and soil aeration, especially as regards their effects on germination and the development of seedlings, is likely to explain much of the existing distribution of different types of vegetation. The remarkable parallelism between different types of woodland and grassland is of considerable economic importance, since grasses in an area may indicate the species and types of woodland for which that locality is most suitable and thus facilitate afforestation.

Prof. A. H. R. Buller, by employing the Barger capillary tube method, has shown that the osmotic

essure of the cell sap of *Pilobolus* is about 5·5, and he d T. C. Vanterpool reported that the so-called condary conidia of the stinking smut fungus are ie basidiospores. Dr. W. P. Thompson and collarators gave a series of important papers dealing with e cytological cause and genetical effects of shrivelled dosperm in species-crosses of wheat, chromosome mologues in wheat and *Ægilops*, and chromosome fferences in the *vulgare* wheats.

Other papers included craniometrical studies inlving a number of new cranial indices (John meron), data concerning the numbers of molecules the red-blood corpuscle (A. T. Cameron), study of ostate extracts with an adrenine-like action (J. B. Collip), new evidence as to the true location of the respiratory centre, in disagreement with Lumsden's work (V. E. Henderson and T. A. Sweet), forelimb reflexes and their reciprocal muscular co-ordination (F. R. Miller), and the temperature limits of *Grylloblatta* (E. M. Walker). Dr. F. C. Harrison gave an important communication on the cause of discoloration of the bellies of Pacific Coast halibut, which he showed to be due to *Ps. fluorescens* introduced by the ice used for packing the fish.

The meeting in 1930 will be held at McGill University, Montreal, under the presidency of Prof. A. S. Eve, Macdonald professor of physics in McGill University.

Afforestation of Peat Lands in Sweden.

FOR a considerable period the Swedish Institute of Experimental Forestry has devoted extensive search to the problem of draining peat and marshy nds for afforestation purposes. Numerous investitions have been carried out with the view of gaining creased knowledge of the various properties of peat il types and their suitability to draining by the dinary forest method of open ditches. The importce of this study to Sweden will be evident when it remembered that half the total exports consist of e produce from her forests, and that it is estimated at there are some 3,000,000 acres of this type of nd which can be made suitable for the growth of ees.

The methods of inquiry projected have been on veral different lines. Earlier types of drainage tches have been studied with their results; and ecial drainage operations have been undertaken on rying types of marsh and peat lands, which have en thoroughly investigated geologically, hydrogically, and biologically. Laboratory investigations ve also been undertaken into the physical and emical properties of various kinds of peat. The reful work thus carried out over a series of years ay have some considerable importance to Great itain, in parts of which extensive tracts of peat nds exist.

The results of the Swedish investigations have been blished in the *Reports of the Swedish Institute of xperimental Forestry*, No. 24 (1927–28), the paper by rl Malmström being entitled "Våra Torvmarker ur ogsdikningssynpunkt". The author states that s paper gives a general review of the results that ve been obtained in regard to the suitability of fferent types of peat ground for draining, both as the possibilities of draining it with advantage d the qualities of the timber to be obtained from it ter the operations.

Investigations into the possibility of extending the ea of forests in Sweden were begun in the middle of st century, coinciding with the commencement of veden's exploitation of the forests to capture a share the European trade in soft woods which were replacg the broad-leaved timbers. Amongst others, C. G. debetow, T. L. Bohnstedt, and Bishop C. A. Agardh vocated ditching as the method by which poor un oductive peat lands might be afforested; the latter ating that the removal of excess water by this eans would also improve the local climate.

Towards the end of the nineteenth century, a ther motive for carrying out this type of drainage eration arose, it being suggested that such drainage uld prevent peat-formations from spreading over ll healthy forest land. At the beginning of the esent century, therefore, the inquiry was considered from the twofold point of view of improving boggy land and as a protective measure, in many cases considered essential to obtain enduring results from good forest lands. The protective idea originated in northern Sweden, where there are extensive areas of poor forest growth where the soil is covered entirely or in patches with carpets of *Sphagnum* and *Polytrichum commune*. The fear of the spread of this type of formation came to be applied to parts of southern and central Sweden, and particularly to areas, as for example in western Småland and north-west Dalecarlia, where widespread complexes of moss are to be found. The investigations by the Institute of Experimental Forestry so far carried out, in this latter direction, are said to have produced "incontestable evidence that at the present time the danger of any general process of rapid bog-formation affecting the forests of Sweden is slight". The caution is added, however, that "this does not mean that locally, *e.g.* in the case of neglecting to clean out ditches, the confluence of streams, deforestation, forest fires, etc., processes of bog-formation cannot take place comparatively rapidly".

The business of improving poor peaty and marshy land in Sweden by laying out a series of ditches has now many enthusiastic adherents, both government and private land owners, and the author deems it necessary, owing to failures which have been experienced, to voice some warnings. Difficulties, he says, very similar to those experienced by farmers when they have sought to utilise certain types of peat land for cultivation purposes, have been experienced by foresters. Just as the farmer learnt by sad experience that it is wasted labour to try to cultivate economically, for example, mosses with large superficial layers of entirely undisintegrated *Sphagnum* peat, the forester now realises that certain types of peat soil react extremely slowly, if at all, after draining; whilst others soon after draining show a considerable and enduring improvement in the forest growth.

On the subject of the amount of water to be drained off, it has been shown that varying types of peat soils display remarkable differences in this respect. Investigation work has accordingly been concentrated on the degree of moisture and the biological properties of peat ground and also on its productive capacity after draining from the forestry point of view, and it is hoped by this means to arrive at an even greater certainty in the selection of areas to be drained and also on the correct method of laying out the system of drains for particular types of peat and marshy areas. The necessity for protective drainage schemes having, as explained above, been proved to be of local importance only, the investigation work is now

concentrated on drainage for afforestation purposes and the work is confined to those classes of peat soil which have so far been shown to respond and to show, without too expensive and elaborate a drainage scheme, a considerable and lasting improvement within a short time. "Peat ground", says the author, "that is hard to drain off and poor in quality, or in which the reaction takes place too slowly, must obviously, according to the present views, be entirely abandoned. It is clear, however, that in the event of drainage operations becoming cheaper or forest products increasing in value, or should it be possible to reduce the administrative and transport costs of lumbering, the poorer types of peat ground may be advantageously treated." The author then deals at length with the drainage possibilities of peat ground, its qualifications for producing timber after draining, and finally considers the conditions governing the most important types of peat land where draining is to be undertaken.

On the subject of classifying peat ground for forestry purposes, Mr. Malmström says that experience has shown that it is not possible unreservedly to use the old schemes of differentiating the types, which were set up on the basis of the topography, the plant associations, or the evolutionary history of the peat ground. Some of these may usually be better than others, but exceptions to this rule have been found. Unfortunately, there is at present no possibility of forming any such judgment in a simple stereotyped way, such as with the guidance of a certain definitely determinable property in the virgin peat soil. The peat's power to react after draining is determined by many contributory factors; as, for example, the composition of the peat, degree of disintegration and porosity, fungal and bacterial life, climate, and, above all, the power of the peat to absorb and retain water.

There is, however, an empirical and, for practical purposes, satisfactory method of judging in advance the qualifications of peat ground for producing timber after draining. This consists in studying the vegetation produced on the peat in its natural state and taking special note of the presence or absence of certain plants. Luxuriant vegetation (especially dwarf shrubs and bushes) often provides a good indication as to the biological conditions of the ground; that is, of those intrinsic properties which, after draining, largely determine the success of forest production, although they are not apparent from direct observation of the plant community. The species of trees and certain bushes and shrubs are particularly helpful. Alder (*A. glutinosa* and *incana*) is a good indication on several types of peat; and spruce and birch may also serve as a sign, especially if the trees have a healthy and normal appearance. The spruce by itself is more uncertain, and where it is stunted and knotty usually indicates a soil unsuitable for drainage schemes. Willows, juniper, and dwarf birch (*B. nana*), if tall and flourishing, indicate peat soils worth draining. When the areas are treeless, experience has shown that the presence of certain grasses, sedges, and herbs will furnish an indication of the peat's disintegration and porosity, especially in south and central Sweden. Plants of this kind are high sedges (*Carices*) and various types of cotton grass (*Eriophorum*): when these are present and the peat is fairly well disintegrated, the area is suitable, whilst the reverse is the case with areas of more or less undisintegrated peat covered with cotton grass and *Scirpus cæspitosus*.

Mr. Malmström's paper may be regarded as a valuable aid in a most important and difficult problem in afforestation in which forest officers in several parts of Europe are vitally interested, and it will well repay a careful study.

University and Educational Intelligence.

BIRMINGHAM.—The Walter Myers travelling studentship for research in any branch of pathology approved by the selection committee is being offered. The value is £300. The holder of the studentship will be required to devote his or her whole time to research. Applications must reach the Dean by at latest Sept. 2.

EDINBURGH.—At the summer Graduation Ceremonial the honorary degree of Doctor of Laws was conferred upon Mr. J. B. Clark, formerly Headmaster of George Heriot's School, Edinburgh; Prof. E. S. Goodrich, Linacre professor of zoology and comparative anatomy, University of Oxford; Prof. A. V. Hill, Foulerton research professor of the Royal Society; Prof. C. E. Inglis, professor of mechanism and applied mechanics, University of Cambridge; Dr. A. P. Laurie, formerly principal of the Heriot-Watt College, Edinburgh; Sir James Walker, professor-emeritus of chemistry; and the Right Hon. Lord Woolavington of Lavington. The degree of Doctor of Science was conferred on Mr. John Mackie, for a thesis entitled "An Inquiry into the Tetrad-difference Method of Testing the Two-factor Theory of Intelligence"; Dr. Christina C. Miller, for a thesis entitled "The Slow Oxidation of Phosphorus"; Dr. Frederick Walker, for a thesis entitled "The Geology of the Shiant Isles"; and Mr. John M. Whittaker, for a thesis entitled "On the Stieltjes Integral and on the Expansions of Interpolation Theory".

The Court has appointed Mr. C. B. Williams to be Steven lecturer in agricultural and forest zoology in succession to Dr. Stewart MacDougall.

MANCHESTER.—Invitations are invited for the Amy Henrietta Worswick Fellowship, value £150, for the investigation of the causes and treatment of rheumatoid arthritis. Applications must reach the Registrar by Oct. 15.

ST. ANDREWS.—By a recent ordinance a chair of botany has been established in the University, placing under the new professor the Departments of Botany in the United College, St. Andrews, and in University College, Dundee. The lectureship in botany in Dundee and the assistant lectureship in the United College as presently existing are continued under the new arrangement, and it has been agreed that the first appointment to the new chair should be offered to Mr. R. A. Robertson, who was appointed lecturer in botany in the United College, St. Andrews, in 1891, and reader in botany in 1915. Mr. Robertson has accepted the offer and has been appointed as from Oct. 1 next.

THE Trustees of the Beit Fellowships for Scientific Research have made the following elections to fellowships tenable at the Imperial College of Science and Technology for two years 1929–30 and 1930–31, of the value of £250 per annum: Mr. N. S. Grace, University of Saskatchewan, Saskatoon, Canada, for physical chemistry; Mr. J. J. Green, Imperial College, for an investigation of the nature and cause of the breakdown in agreement between the theoretical and observed viscous fluid motion round a circular cylinder; Dr. F. K. V. Koch, Imperial College and Universities of Dresden and Munich, for the continuation of an inquiry into the solution tension of silver in solvents other than water, and the connexion between solution tension and complex formation. The Trustees have confirmed the awards for a second year to Mr. A. A. Fitch (geology); Mr. J. M. Frankland (metallurgy); Mr. E. C. S. Megaw (electrical engineering).

Calendar of Patent Records.

July 23, 1888.—J. B. Dunlop's patent for the pneumatic tyre is dated July 23, 1888. Though his invention had been anticipated in the year in which he was born, more than forty years earlier, by R. W. Thomson, the popularity of the bicycle at the later date provided a rapidly growing market for the new tyre, and it is on Dunlop's work and enterprise that the present industry is based.

July 24, 1874.—The game of lawn-tennis was gradually developed from the older games, tennis, rackets, and badminton, and its actual beginnings are hard to determine, but the first to formulate and codify definite rules and a lay-out for the court was Major W. C. Wingfield, who patented his game on July 24, 1874, under the name of 'Sphairistiké'. Wingfield's court was narrower at the net than at the serving lines, and this form was adopted by the M.C.C. committee when it published its rules in 1875, but the rectangular court with practically the present dimensions was general by 1877. The cloth-covered ball is due to John Heathcoat, the tennis-player.

July 25, 1698.—The first steam engine successfully to operate—for pumping water out of mines, one of the great problems of the day—was the invention of Thomas Savory, who was granted a patent on July 25, 1698, and published an account of the invention in 1702 in his book "The Miners' Friend". The life of the patent was extended for 21 years by Act of Parliament in 1699.

July 26, 1588.—Modern shorthand dates from the patent granted on July 26, 1588, for 15 years, to Dr. Timothy Bright, resident physician at St. Bartholomew's Hospital, which licensed him "to teache, imprynte, and publishe, or cause to be taughte, imprynted, and published, in or by character not before this time commonlye knowne and used by any other oure subjectes". In the same year Bright published a description of the system in his book "Characterie. An arte of shorte swifte and secrete writing by character". A specimen, dated 1586, is in the Lansdowne MSS. in a communication to Sir Robert Cecil.

July 26, 1810.—J. C. Dyer's patent for a nail-making machine, dated July 26, 1810, is an important landmark in the history of the nail industry. There was considerable difficulty in getting the machine adopted, but finally a company was formed in London to work the invention and works were opened. By 1817, the machine-made nails had become a serious competitor in the market, as is evidenced by a petition to the House of Commons, which, referring especially to Dyer's factory, directed attention to "the ruin of the trade and devastation of the country" that was being brought about by the new industry.

July 26, 1811.—A patent was granted on July 26, 1811, to Henry James and John Jones for a method of welding gun-barrels by means of a series of hammers and for a lathe for turning barrels instead of grinding them. Jones was later employed by the Russian Government in the State Arsenal, where he re-designed all the machinery and organised the factory on the 'interchangeable' system.

July 26, 1907.—The Garratt articulated locomotive, which provides a very flexible engine and allows of a wide increase in the steam-generating capacity within the limits imposed by the width of the track and the loading gauge, was invented by H. W. Garratt, of London, and patented by him on July 26, 1907. The first engine of the type was made by Beyer, Peacock, and Co., in 1909, for the Tasmanian Government Railways, and the development has since been continuous and rapid.

Societies and Academies.

LONDON.

Geological Society, June 12.—E. Mackenzie Taylor: Base exchange and its bearing on the formation of coal and petroleum. The discovery of a bed of vegetable débris containing both peat and fusain under a layer of alkaline soil in Egypt led to the investigation of the effects of the presence of sodium-clay upon the decomposition of organic matter by bacteria. The alkaline soil was shown to be a sodium-clay produced by base exchange between the clay and solutions of sodium chloride. As the result of hydrolysis, a continuously alkaline medium under anaerobic conditions was produced in which continuous bacterial action is possible as the acidic products of such action do not accumulate. Lignocellulose decomposes under these conditions, yielding a material with fusain properties. The decomposition of proteins and fats takes place in the alkaline medium, and, in addition, it has been found possible to decompose free organic acids by bacteria under these conditions. It was suggested that coal and petroleum have both resulted from the decomposition of organic matter by bacteria, under the alkaline anaerobic conditions provided by strata which have undergone base exchange with solutions of sodium salts and subsequent hydrolysis in fresh water. The conditions provided by such strata are favourable to continuous bacterial action, to the elimination of oxygen from the material, and to the accumulation of the decomposition products as the result of the sealing of the organic deposit.

Physical Society, June 28.—Teresa J. Dillon: The relation between hydrogen pressure and filament resistance in a tube containing glowing tungsten. When a tungsten filament in a tube containing hydrogen is caused to glow, the gas rapidly disappears while the resistance of the filament rises progressively. The latter phenomenon can be used to measure the pressure of the hydrogen. Chemical action probably takes place between the hydrogen and tungsten.—Francis Lowater: The band systems of titanium oxide. The bands extend toward the infra-red through some 800 A. farther than the range previously known. Bands in the orange, red and infra-red regions have been analysed into two systems, distinct from the blue-green system, one of these being due to the transition $^1\Pi \rightarrow {}^1\Sigma$, the other to $^3\Sigma \rightarrow \Pi^3$, the latter having the same final energy level as the blue-green system $^3\Pi \rightarrow \Pi^3$.—F. D. Smith: The absolute measurement of sound intensity. The sound is received with a moving coil receiver. The signal heard after suitable amplification is compared with the signal produced by a small known electromotive force applied to the receiver. When the two signals are equal in intensity a simple relation connects the total sound pressure on the receiver with the electromotive force. The phase of the sound can be determined with the aid of a phase-shifting transformer. Since the measurement is independent of the amplifying circuit, it is possible to use a high degree of amplification and very feeble sounds may therefore be measured.

LEEDS.

Philosophical Society, June 17.—R. Stoneley: Love waves of short wave-length. The calculation of the velocity of propagation of transverse surface waves involves a knowledge of the rigidity and density of the medium at all depths. The velocity of very short waves, however, is determined mainly by the properties of the layers near the surface; an asymptotic formula for such waves is developed which depends

on the surface values of the rigidity and density and of their gradients.—**A. O. Allen**: A simplified derivation of v. Seidel's aberration formulæ (2).—**E. C. Stoner**: Diamagnetism and space charge distribution. The diamagnetic susceptibilities corresponding to the space charge distributions obtained by the Hartree self-consistent field method are calculated for He, Li^+, Na^+, K^+, Rb^+, and Cl^-. Except for Cl^-, there is very satisfactory agreement with experiment.—**R. Whiddington**: (1) Some new discharge tube phenomena. Experiments are described using a straight argon-filled discharge tube showing moving striations. There are at least four types of moving striations from flashes possible at one pressure, the type produced depending on the current employed. The change from one type to another is accompanied by an unstable system which is described but not explained. With a steady source of potential applied to the tube, the majority of the current is steady, but superposed on this steady current is a slight flicker amounting to a small percentage only of this whole current. Oscillograph measurements of this flicker show interesting variations of wave form with change of total current. These changes again are described but not explained. (2) A note on the use of the cathode ray oscillograph. A cathode ray oscillograph is often used for indicating the wave form of alternating currents by the associated use of a winking Osglim lamp. The winking frequency and the alternating current frequency must bear some simple integral ratio for this method to be applicable. For certain experiments it was found desirable to superpose a time mark of 50,000 frequency on that of the Osglim lamp so that the trace corresponding to the alternating wave would be segmented at equal time intervals, presenting an appearance somewhat like that of a string of beads. A method of carrying this out is described in which an oscillating valve circuit of about the desired frequency is suitably linked to the lamp, the frequency ratio of the two being again some simple multiple.—**R. Gane**: Carbohydrate content of detached partially shaded leaves. Sucrose and reducing substances are estimated in the distal, median and proximal portions of leaves isolated from the plant; the median portions had been shaded, whilst the rest of the leaf had been exposed to light. Certain differences in the sugar content then found in the leaf seem to be associated with the shading, but the differences do not seem adequate to explain the complete failure of starch to appear in the shaded strip. The distribution of sugars in plantain leaves thus treated, and in those in which the main veins had been removed, suggests that sugars can still move into the shaded region from illuminated ones, in spite of the dislocation of the vein system.—**W. Garstang**: On the dextricolic condition in Tunicates. The author republishes two figures from Barrois which establish the dextricolic condition of *Anchinia* buds, recently disputed by Van Wijhe. Their 'neural cord' is a 'neurogenital cord', comparable with that of *Aplidium* (Brien), but lying in a dextral, instead of a sinistral loop of the gut,—a complete *situs inversus*. The key to this condition is sought in the origin of salps and doliolids from colonial (pyrosomatoid) ancestors, and in the part played by subsequent rearrangements of the gut in balancing the body of free zooids for a locomotive career.

PARIS.

Academy of Sciences, June 10.—The president announced the death of M. Georges Lecointe, *correspondant* of the Academy for the Section of Geography and Navigation.—**Maurice Hamy**: A particular case of diffraction of the solar images at the focus of a telescope. It has been shown in earlier communications that the problem requires the calculation of some very complex double integrals. The evaluation of one of these integrals is dealt with in the present paper.—**Charles Moureu, Charles Dufraisse, and Léon Enderlin**: Researches on rubrene. A new oxide of rubrene. It is known that rubrene can fix a molecule of oxygen giving the oxide RO_2, readily dissociable into rubrene and oxygen. The preparation of another oxide, RO, is now described. This is more stable, is not dissociable into its constituents, but can be reduced to rubrene with ordinary reducing agents. It cannot be converted into the oxide RO_2. There is a close analogy between rubrene, the oxides RO_2, and RO and hæmoglobin, oxyhæmoglobin and methæmoglobin. It is concluded that the characteristic properties of hæmoglobin are not necessarily due to the presence of an atom of iron.—**V. Grignard and Tchéoufaki**: New researches on the additive properties of the α-diacetylene hydrocarbons. Experiments on the products formed by the addition of bromine, hydrobromic acid, and hydrogen to these diacetylene derivatives.—**Jules Drach** was elected a member of the Section of Mechanics in the place of the late J. Boussinesq.—**A. Gelfond**: Picard's theorem.—**Josef Mikuláš Mohr**: The absolute velocity of the sun.—**P. Salet**: The constancy of the velocity of light.—**Holweck and Lejay**: The preliminary study of a quartz tuning fork in a high vacuum. In the apparatus described, once the fork is started in oscillation, several hours elapse before the amplitude of the oscillations is reduced to one-half. The period was proved to be independent of the amplitude and constant within the limits of the accuracy of the measurements, about 0·0001 sec. Possible applications of the instrument are suggested.—**C. Raveau**: The rule of the four directions: Chatelier's principle.—**Henri Chaumat**: Electrostatic machines working with condensers.—**Gaston Rapin**: Attempts at the direct electrolytic preparation of ammonium permanganate. With an anode formed of silico-manganese in an ammoniacal solution, ammonium permanganate can be prepared directly, but on account of the low electrical conductivity of the ammonia solutions the method is of theoretical value only.—**S. Rosenblum**: The fine structure of the magnetic spectrum of the α-rays. The α-rays emitted by the radioactive substances radium-A, -C′ and thorium-C′ have been examined: the velocities of the α-rays attributed to these bodies are very homogeneous.—**F. Vlès and A. Ugo**: Some properties of the electromotive forces developed in contact with aqueous solutions of electrolytes of variable *p*H and salinity.—**Georges Fournier**: A magnitude permitting a new classification of atoms. Neither the atomic number N, nor the atomic weight A, completely defines an atom. The quantity $U = \frac{3}{4}A - N$ is suggested and is regarded as representing its filiation capacity.—**Guy Emschwiller**: The action of the zinc-copper couple on methylene iodide. In ether solution, ethylene is evolved and an organozinc compound formed. The latter appears to be zinc-iodomethyl iodide, ICH_2ZnI. With iodine, methylene iodide is regenerated; with water, methyl iodide, zinc hydroxide and zinc iodide are produced.—**Henri Moureu**: The tautomerism of the α-diketones. Heat of transformation of the isomers. The heat of transformation of the α-diketones (methylbenzylglyoxal, phenylbenzylglyoxal) is of the order of 2·5 large calories per molecule. This was determined in two ways, one based on the thermodynamic relation between the heat of transformation and the thermal variation of the equilibrium constant, the other on the heats of combustion.—**Jacques Bourcart and A. Keller**: The geological

sults of the Augiéras-Draper Sahara expedition retaceous and Eocene).—**Henri Erhart**: The nature d origin of the soils of Madagascar.—**Charles Rabot**: ne abnormal arrival of icebergs on the north coast Norway. For the first time on record, numerous ebergs (from Nova Zembla or Franz-Joseph Land) ve appeared on the north coast of Norway dur- g May last.—**R. Bureau**: Pressure and tempera- re by radiotelegraphy.—**Roger Heim**: The vasi- rm apparatus (*hyphes*) of the Agaricaceæ.—**Robert mesle**: The embryogeny of the Elatinaceæ. The velopment of the embryo in *Elatine Alsinastrum*. **J. Loiseleur**: The modifications of the collagen bstances under the action of the radiation from dioactive bodies. The β-radiation of radium or of don effects a profound alteration in the colloidal ate of collagen substances; salts of the heavy etals (lead acetate, gold chloride) sensitise the col- gen to the action of the radiation. The phenomenon independent of the temperature between 0° C. and ° C. and is proportional to the intensity of the diation.—**Lamberton**: The Archæoindris of Mada- scar.—**Robineau and Contremoulins**: Examples of ntheses and protheses in bone, in metal uncovered covered with rubber, established on metroradio- aphic data. Observations continued over several ars show that the tolerance of the organism is mplete if the mounting on the bone is correctly rried out.

CAPE TOWN.

Royal Society of South Africa, April 17.—**J. L. B. ith and R. H. Sapiro**: Some derivatives of thiazole. **G. E. Hutchinson, G. E. Pickford, and J. F. M. huurman**: Report on the natural history of pans and ner freshwaters of the Transvaal (see also NATURE, ne 1, p. 832).—**H. N. Dixon and H. A. Wager**: w and noteworthy mosses from South Africa.—**F. J. Schonland**: Thunderstorms and the penetrat- g rays. The main feature of the instrument used is electroscope in which the moving part is a very ht mica mirror suspended by two fine strips of gold f. Measurements of the intensity of the penetrat- g radiation underneath five active thunderstorms l not differ appreciably from measurements made ring periods of fine weather.—**W. A. Jolly**: On ording lymph-heart beats. The work was under- ken with the object of studying the action of the mph-hearts in Anura when the conditions are as arly as possible normal. The method employed is at of the optical lever. A minute fragment of vered cover-glass is placed on the skin—to which adheres—where the impulse is most distinct, and beam of light reflected from this mirror is focussed the slit of a photographic recorder furnished with oll of sensitised paper. The beat of the lymph- art recorded in this way is remarkably regular. e beat action is not continuous, but shows periods en it becomes very small or ceases altogether.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences cond class, Natural Sciences and Medicine), ril 12.—**Fr. Ulrich**: Variscite and barrandite from nice, near Zbiroh.—**J. Švéda and R. Uzel**: De- mination of tin by rapid electro-analysis. After a ical examination of electro-analytical methods for the authors have worked out as the most reliable thin 0·32 per cent tin) the procedure in which tin leposited electrolytically from acid oxalate solu- is of stannous and stannic salts in the presence hydroxylamine.—**J. Bašta**: New aspects of the bility, resistance, and fragility of rails and wheels ailway engineering.

May 31.—**J. Wolf**: The organic cement substance of the bone and of the dentin.—**V. Tůma**: Histological changes in rats during avitaminosis.—**J. Janatka**: The development, structure, and significance of the nucleus pulposus of the intervertebral discs.—**J. Nešpor**: Differentiation and de-differentiation of the tissue cultures from the viewpoint of the vitality measurements.—**F. Chudáček**: Calcification of the costal cartilages.—**V. Janko**: The insular tissue of the adult pancreas of the Cyprinides, its form and its relation to the excretory system.—**M. Uher**: The development of the nervous elements *in vitro*.—**M. Mikan**: A certain Cremona correspondence in quadri-dimensional space.—**J. Sobotka**: A contribution to the solution of the generalised problem of Apollonius.—**J. Charvát and D. Gjurič**: The cause of Basedow's glycosury.

ROME.

Royal National Academy of the Lincei, April 21.—**V. Volterra**: Observations on hereditary phenomena.—**G. Loria**: The scientific manuscripts of Francesco Siacci.—**A. Tonolo**: Classification of the surfaces of Hilbertian space, the 2-tangent space of which is of four dimensions (1).—**L. Fantappiè**: Linear functional equations in the complex field.—**G. Mammana**: Certain applications of the theory of the decomposition of linear and homogeneous differential expressions to the study of homogeneous linear differential equations.—**Pia Nalli**: Derivation of a tensor along a line.—**A. Mambriani**: A theorem relative to ordinary differential equations of the second order.—**G. Scorza-Dragoni**: A particular differential equation.—**E. Pini**: The existence of integrals of ordinary differential equations.—**D. Pompeiu**: The unicity of the prolongation of harmonic functions.—**A. Palatini**: Einstein's new theory. By means of his new theory, and starting from a principle of Hamilton with an appropriate universal function, Einstein has arrived at satisfactory analytical results. These are, however, only a first approximation, and the methods adopted do not render it easy to follow the corresponding exact equations, which have not yet been obtained. In the present note it is shown how, by the systematic use of known operations, without further formal complications, such equations are readily derivable.—**L. Genovese**: Comparison of the photographic magnitudes of various zones of the Astrographic Catalogue.—**A. Belluigi**: Simple and rapid processes of topographic correction.—**C. Mineo**: Relations between the parameters of terrestrial ellipsoids and the values of gravity.—**I. Ranzi**: Phenomena of negative resistance in a diode subjected to a magnetic field.—**A. Occhialini**: The charge of emission centres as shown by the polarity of the electrodes. The results of experiments with magnesium, mercury, and lead show that, for each element, the ratios between the lengths of the lines for positive and negative polarity are equal for lines emitted from centres having the same charge, and different, and increasing with the order of ionisation, for lines emitted from centres ionised differently. These results may be utilised for distinguishing spark lines according to the order of ionisation of the emitting atom.—**S. Di Franco**: Natrolite from Viagrande (Etna). Crystals of natrolite found in the cavities of a very old, reddish lava show the specific gravity 2·19-2·21 and the axial ratios $a : b : c = 0{\cdot}978523 : 1 : 0{\cdot}353626$, which agree well with the measurements made by Brögger on Norwegian natrolite. No deviation in the direction of extinction is observable. Most of the water present in the mineral is expelled within a somewhat narrow range of temperature, namely, 290°-305°.—**M. Comel**: The

physiological action of strontium. Continued endomuscular administration of strontium hexose-oxypropionate to fowls causes a characteristic intoxication developed at the expense of the nervous system. The first symptom is wasting accompanied by a voracious appetite, nervous changes appearing later. The symptoms as a whole are reminiscent of those produced by lack of vitamin B and are to some extent attenuated by administration of this vitamin.—C. Guareschi: The otocysts of anuran amphibia considered as a mosaic system.—S. Pastore: A special method of staining malaria parasites.

Official Publications Received.

BRITISH.

City and Guilds of London Institute. Annual Report of the Council to the Members of the Institute, 1928. Pp. xlix+72. (London.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 12: Technological Reports on Standard Indian Cottons, 1929. By A. James Turner. Pp. iv+125. (Bombay.) 2 rupees.

Report of the Nineteenth Meeting of the Australasian Association for the Advancement of Science (Australia and New Zealand). Hobart Meeting, January 1928. Edited by Clive E. Lord. Pp. xl+707. (Sydney, N.S.W.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 14: Studies on the Scottish Marine Fauna; The Fauna of the Sandy and Muddy Areas of the Tidal Zone. By A. C. Stephen. Pp. 291-306. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1195: A Mechanical Method for Solving Problems of Flow in Compressible Fluids. By G. I. Taylor and Dr. C. F. Sharman. Pp. 21+1 plate. 1s. net. No. 1197 (Ae. 358): Wing Flutter Experiments upon a Model of a Single Seater Biplane. By W. G. A. Perring. (T. 2684.) Pp. 20+10 plates. 1s. 3d. net. No. 1216 (Ae. 375): The Lift and Pitching Moment of an Aerofoil due to a Uniform Angular Velocity of Pitch. By H. Glauert. (T. 2687.) Pp. 9+2 plates. 9d. net. No. 1219 (M. 59): Investigation into the Proposed Use of a Sand Cast Test Bar for Specification Purposes for Aluminium Alloys. By Dr. W. Rosenhain and S. L. Archbutt. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (A. 55.) Pp. 9. 6d. net. No. 1225 (Ae. 380): Wind Tunnel Tests of a R.A.F. 30 Wing fitted with a Self-setting Slotted Wing (Pilot Plane). By F. B. Bradfield and S. Scott Hall. (T. 2471.) Pp. 12+4 plates. 9d. net. No. 1226: The Characteristics of a Tapered and Twisted Wing with Sweep-back. By H. Glauert and S. B. Gates. (T. 2730.) Pp. 19+4 plates. 1s. net. No. 1236 (Ae. 391): The Control of the Fokker F. VII.-3M Aeroplane. Interim Report by the Stability and Control Panel, with an Appendix giving Précis of Pilots' Reports. (T. 2408.) Pp. 5. 4d. net. (London: H.M. Stationery Office.)

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1928 May 19–1929 May 18. Pp. 3. (Cambridge.)

Journal of the Royal Microscopical Society. Series 3, Vol. 49, Part 2, June. Pp. 91-209+xvi. (London.) 10s. net.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 13, Part. 1. Pp. 69+15 plates. Vol. 13, Part 2. Pp. 71-121. (Pretoria.)

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Period ended 30th September 1928. Pp. v+71+10 plates. (London: H.M. Stationery Office.) 3s. net.

Association of Technical Institutions. Paper read at the Summer Meeting, June 27th, 28th and 29th, 1929, on "The Relation between the Technical College and the Local University", by Principal W. A. Richardson. Pp. 19. (Loughborough: Loughborough College.) 6d.

FOREIGN.

Proceedings of the Imperial Academy. Vol. 5, No. 5, May. Pp. ix-xii+183-221. (Tokyo.)

Instituto Central Meteorológico y Geofisico de Chile. Publicación No. 38: Anuario Meteorológico de Chile de 1925. Pp. iv+163. (Santiago.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 10, 1928. 2: Nederbörden i Sverige. Pp. 160. (Stockholm.) 5.00 kr.

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1928. Erstattet von Dr. R. Schorr. Pp. 26+4 Tafeln. (Bergedorf.)

The Rockefeller Foundation. A Review for 1928. By George E. Vincent. Pp. 54. (New York City.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 4: Illiteracy in the Several Countries of the World. By James F. Abel and Norman J. Bond. Pp. vi+68. (Washington, D.C.: Government Printing Office.) 15 cents.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 98: Further Studies on the Value of Non-virulent Living Culture Vaccination of Cattle against Brucella Abortus Infection. By I. Forest Huddleson. Pp. 11. Chart Section of Technical Bulletin No. 98: Herd Charts. By I. Forest Huddleson. Pp. 15. (East Lansing, Mich.)

Smithsonian Miscellaneous Collections. Vol. 73, No. 6: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 105 to 114. (Publication 3016.) Pp. 26. (Washington, D.C.: Smithsonian Institution.)

Cornell University: Agricultural Experiment Station. Bulletin 470: Pollination of Greenhouse Tomatoes. By H. W. Schneck. Pp. 60. Bulletin 471: An Economic Study of Retail Feed Stores in New York State. By E. A. Perregaux. Pp. 61. Bulletin 472: Sizes of Purchasing Centers of New York Farm Families. By Helen Canon. Pp. 15. Bulletin 473: The Cost of Handling Fluid Milk and Cream in Country Plants. By C. K. Tucker. Pp. 119. Bulletin 474: The Fumigation of Greenhouses to destroy Insect Pests. By Glenn W. Herrick and Grace H. Griswold. Pp. 20. Memoir 118: Wheat Prices and the World Wheat Market. By Vladimir Prokopovich Timoshenko. Pp. 100. Memoir 119: Prices of Fertilizer Materials, and Factors affecting the Fertilizer Tonnage. By Edmund Ellsworth Vial. Pp. 159. Memoir 120: A Physiological Study of Dormancy in Vetch Seed. By John Paul Jones. Pp. 50. Memoir 121: Variation and Correlation in the Appendages of the Honeybee. By E. F. Phillips. Pp. 52. Memoir 122: The Effect of Freezing on the Catalase Activity of Apple Fruits. By D. B. Carrick. Pp. 18. Memoir 123: Three Rust Diseases of the Apple. By H. E. Thomas and W. D. Mills. Pp. 21. (Ithaca, N.Y.)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 68, No. 1. Pp. 68. (Philadelphia, Pa.)

The List of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Pp. 28. (Philadelphia, Pa.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 13, No. 2. Pp. 17-33+plates 9-10. (Tokyo and Sendai: Maruzen Co., Ltd.)

Proceedings of the United States National Museum. Vol. 74, Art. 11: Synopsis and Description of North American Tadpoles. By A. H. Wright. (No. 2756.) Pp. 70+9 plates. Vol. 75, Art. 1: Mammals from China in the Collections of the United States National Museum. By A. Brazier Howell. (No. 2772.) Pp. 82+10 plates. Vol. 75, Art. 24: Tertiary Fossil Plants from Colombia, South America. By Edward W. Berry. (No. 2795.) Pp. 12+5 plates. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Constable Announcements. Summer–Autumn 1929. Pp. 12. (London: Constable and Co., Ltd.)

The Cambridge Bulletin. No. 63, June. Pp. 24+4 plates. (Cambridge: At the University Press.)

Catalogue of Cine Cameras and Projectors. Pp. 16. (London: Sands Hunter and Co., Ltd.)

McGraw-Hill Books on Radio Engineering, Telegraphy and Telephony. (List 11, second edition.) Pp. 10. McGraw-Hill Books on Astronomy, Mathematics, Meteorology, Physics. (List 13, second edition.) Pp. 16. (London: McGraw-Hill Publishing Co., Ltd.)

Diary of Societies.

TUESDAY, JULY 23.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY.—Summer Meeting at Dartmouth (jointly with the Devonshire Association) to Commemorate the Bicentenary of the Death of Thomas Newcomen (continued on July 24, 25, and 26).

THURSDAY, JULY 25.

ROYAL AERONAUTICAL SOCIETY (at Science Museum, South Kensington), at 9 P.M.—The Hon. W. P. MacCracken, jun.: Science in its Relation to Regulating and Promoting Civil Aviation (Wilbur Wright Memorial Lecture).

CONFERENCES.

JULY 23 TO 26.

BRITISH MEDICAL ASSOCIATION (at Manchester).

Tuesday, July 23, at 8 P.M.—Prof. A. H. Burgess: The Debt of Modern Surgery to the Ancillary Sciences (Presidential Address).

Wednesday, July 24, at 10 A.M.—Sections of Medicine, Surgery, Obstetrics and Gynæcology, Diseases of Children, Neurology and Psychological Medicine, Physiology and Biochemistry, Pathology and Bacteriology, Oto-Rhino-Laryngology, Ophthalmology, Radiology and Radio-Therapeutics, Venereal Diseases, Orthopædics, Tuberculosis (also at 11.30 A.M.), Public Health (also at 11.30), Occupational Diseases.

Thursday, July 25, at 10 A.M.—Sections of Medicine, Surgery, Obstetrics and Gynæcology, Diseases of Children, Neurology and Psychological Medicine, Physiology and Biochemistry, Pathology and Bacteriology, Oto-Rhino-Laryngology (also at 11.30 A.M.), Ophthalmology, Anæsthetics, Dermatology, Radiology and Radio-Therapeutics, Venereal Diseases (also in afternoon), Orthopædics, Tuberculosis (also at 11.30), Public Health, Occupational Diseases.

Friday, July 26, at 10 A.M.—Sections of Medicine, Surgery, Obstetrics and Gynæcology, Diseases of Children, Neurology and Psychological Medicine, Physiology and Biochemistry, Anæsthetics, Dermatology, History of Medicine, Medical Sociology.

At 7.30 P.M.—Prof. A. V. Hill: Experiments on Frogs and Men (Popular Lecture).

JULY 25 TO 31.

LEAGUE OF NATIONS UNION SUMMER SCHOOL (at New College, Oxford).

JULY 25 TO AUGUST 2.

FRENCH ASSOCIATION (at Havre).

NATURE

SATURDAY, JULY 27, 1929.

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The Advancement of Science in South Africa.

TWENTY-FOUR years ago the British Association visited South Africa for the first time, and now, by invitation of the South African Association for the Advancement of Science, the parent body is again in Cape Town. Mr. Jan H. Hofmeyr's inaugural address, which is printed in the supplement to this issue of NATURE, indicates the remarkable advances made since 1905 in South Africa in almost every branch of science. Mr. Hofmeyr very properly recognises the great service of the late Sir David Gill to science in South Africa in the early part of this century. Without him there would have been no body in South Africa corresponding to the British Association, for to him, and to a lesser extent Sir Charles Metcalfe, the existence of the South African Association is largely due. Sir David was not only a great astronomer, but also a very inspiring and attractive personality.

In 1905 there were four separate States, each enjoying, under the Crown, a very large measure of independence. Two of them, the Transvaal and the Orange Free State, as a result of the war, were still under Imperial tutelage, but in 1907 they were given full responsible government. It cannot be truthfully stated, however, that these four States formed a very happy family; indeed, the exact converse was the case, but in 1910 all came together and formed what is now known as the Union of South Africa. It was then that the real advances in scientific work started, for, thanks largely to a bulging Transvaal treasury, government departments were properly staffed with scientific workers. When it obtained responsible government in 1907 the Transvaal showed the way, possibly because it had the necessary money, and the world-renowned Veterinary Station at Onderstepoort to which Mr. Hofmeyr refers was actually planned before union took place.

Twenty-four years is not a long period, but possibly no other country has experienced such changes within a similar time. Governmental changes have already been indicated, but the whole country's physical aspect has altered almost beyond recognition. Vineyards, orchards, plantations, and trim homesteads now abound where formerly there was nothing but bare veldt. The flocks of sheep and cattle have increased beyond the wildest dreams of those who can recall the conditions of 1905. It is true that ostriches, thanks to fickle fashion, have decreased for the moment, as have also Angora

goats, but the nuclei of potentially important industries still remain. Great stretches of country which were deadly to man and beast are now being successfully farmed and healthy children are being reared. The fight against animal and plant diseases has been waged without ceasing and, thanks to the vigilance of an alert staff of scientific workers attached to the agricultural department, great victories have been won. In this connexion the work of Lord Milner must never be forgotten, for it was he, and no other, who laid the foundations of a scientific agricultural policy the results of which are so apparent to-day. This fight has been waged in the laboratories as well as in the veldt. Twenty-four years ago South Africa was importing many of its everyday food requirements, such as butter, cheese, and bacon. To-day she is exporting all these and many others, but she has still to import a considerable proportion of her wheat.

Sir Thomas Holland, the new president of the British Association, will find much to interest him in his own line of work, for in spite of the triumphs of agricultural science, South Africa is still in the minds of the public mainly a producer of gold, diamonds, and, to a minor extent, of platinum. The Geological Survey, from the merely material point of view, has brought much wealth to the country as a whole through its discoveries and surveys, and in Northern Rhodesia a most ambitious scheme of geophysical survey is now being undertaken. Two years ago, at the Empire Mining and Metallurgical Congress held in Canada, Sir Thomas delivered an epoch-making address in which he advocated the necessity of making a review of the mineral resources of the Empire, and though nothing tangible has resulted, his views have not been forgotten; and South Africa, which is probably as well known geologically and mineralogically as any other country in the world, is still capable of springing mineralogical surprises which increase her potential wealth. It is true that many, indeed most, of the discoveries have been made by the old-time prospector, but it looks as if the new geophysical methods were likely to oust that picturesque character from his most interesting occupation.

Then, although the Rand and Kimberley are still the most important mining centres, they have ceased to be the only ones. Indeed, it looks as if Northern Rhodesia will at no distant date rival the Rand with regard to the value of its output of copper and other metals and minerals. But throughout the Union itself there are many centres of mining activity concerned with the actual mining and subsequent treatment of coal, platinum, chrome, asbestos, mica, tin, manganese, magnesite, beryl, and other minerals of minor importance.

Not many years ago, the exports from South Africa were made up almost entirely of gold and diamonds, but to-day the agricultural products, as Mr. Hofmeyr points out, very nearly equal in value the mineral exports, and it is anticipated that at no distant date they will even exceed them. These great advances are undoubtedly due to the application of scientific principles, and although the amount of research work carried out in the laboratories of the four teaching universities of the country is comparatively small at the moment, that work is undoubtedly of paramount importance to South Africa itself.

Mr. Hofmeyr refers with justifiable pride to the great advances which have been made in university teaching—advances in which he himself took no mean part. There is, however, just a doubt as to whether they have not been too rapid for a country which, after all, has a white population of only a million and a half. Probably they were inevitable, as the distances between populous centres are very great, and there has always existed a healthy provincial patriotism which has made for duplication of services generally. There are, for example, two well-equipped medical schools when probably one is quite sufficient for the country's requirements. There is also overlapping in certain specific subjects. If, in the fullness of time, one of the existing universities could be developed for research and post-graduate teaching, the country would undoubtedly be the gainer. At present there is too much teaching and too little research, and yet, as has already been indicated, the output is quite considerable South Africa is fortunately very rich in historical archives, and thanks to Mr. Graham Botha, Sir George Cory, Prof. Eric Walker, and many other earnest workers, these are being rescued from comparative oblivion and made public.

Then, again, thanks to a few ardent workers inside and outside the universities, the origins of the native races, their languages, their folk-lore, and their customs, are being studied to-day as never before. The natives are being rapidly civilised, their old tribal customs are gradually dying out, and the authority of the chiefs, except in the native reserves, has practically disappeared. Nothing quite satisfactory has yet taken its place. The black man is South Africa's greatest problem to-day. All others fade into relative insignificance, and it will take the combined wisdom of both the

dominant races to reach a solution. The members of the British Association cannot be expected to grasp all the ethnological, economic, and political aspects of this great and most difficult problem in the short time at their disposal, but they can at least regard it from an entirely detached point of view.

Those who were living in South Africa at the time of the last meeting there of the British Association wondered very naturally what would be the effect of that very inspiring experience. They felt that they were on the eve of great happenings, but no one could predict what these would be.

Looking back, we find it difficult even to-day to assess the benefits which accrued to the country as a whole. Both visitors and hosts were undoubtedly inspired by the interchange of thought and experience, and it was surely no coincidence that, immediately after the visit, South Africa as a whole set out to wage scientific warfare on its all too numerous pests and parasites, to discover the possibilities of new forms of agriculture, and to inaugurate a more extensive geological survey campaign. The people as a whole, and those who were responsible for the government of the country, had their thoughts very definitely directed to the application of scientific endeavour.

Those who live in South Africa, and those outside it who endeavour through sheer love of that great country to keep in touch with its many problems, again feel that they are on the eve of great happenings. What they will be no one can say, but the members of the British Association will find a better educated community, a more receptive public, and a greater appreciation of the benefits of science among all classes than on the last occasion. They will also find a very healthy spirit of nationalism, developed largely since the War, but finding expression in all walks of life. Nevertheless, they are assured in advance of a hearty welcome from all sections of the community, and we have no doubt that not only will the present visit be as inspiring as the last, but also that its results will be infinitely more beneficial, not to South Africa alone, but to the whole of the British Empire and to the world at large.

The British Association when it visits an outpost of the Empire acts as a catalyst; little is known about the methods whereby these mysterious bodies exercise their equally mysterious effects, but they are nevertheless perfectly definite. South Africa is a splendid field for this catalyst, and we are sure that the stimulus afforded by the present meeting will be felt for many years.

A Classic of Physics.

The Collected Works of J. Willard Gibbs. In 2 vols. Vol. 1: *Thermodynamics.* Pp. xxviii + 434. 15*s.* net. Vol. 2: Part i., *Elementary Principles in Statistical Mechanics*; Part ii., *Dynamics, Vector Analysis, and Multiple Algebra, Electromagnetic Theory of Light, etc.* Pp. xviii + 207 + vi + 284. 15*s.* net. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1928.) 2 vols., 25*s.* net.

THE writings of Gibbs on thermodynamics and statistical theory were far and away the most complete of the early presentations of those subjects, but there must be many with a good knowledge of the theories who have never consulted the originals. As his works have long been out-of-print, the editors have performed a most valuable service in bringing out the present two volumes. They are beautifully printed, and the editors are to be congratulated on having adopted the right method for the re-issue of a classic; a commentary will certainly be useful, and one is to be composed by a number of authorities, but the present books are not disfigured by footnotes in the manner so often practised by energetic but injudicious editors.

It is well known that Gibbs's work did not meet with great appreciation for many years, and after reading his papers it is interesting to consider why. We can imagine some elder of the Connecticut Academy after one of their meetings telling him as delicately as possible that he could not understand what the "Heterogeneous Equilibria" was about; and then Gibbs would go home and amplify it, expecting thereby to make it as clear to others as to himself. The result is that, once the chief idea is grasped, the whole is discussed in such great detail that it could scarcely be improved in ease or clearness. The whole trouble is at the beginning, and depends on the reader being able to *feel* the meaning of $d\epsilon \geqslant td\eta - pdv - \mu_1 dm_1 - \mu_2 dm_2 - \ldots$ (Gibbs always considers the case of inequality with care), and for most of us it is unfortunately a considerable step from admitting the logic of the equation to the intuitive understanding of it. It is hard to see how amplifying his introduction would have helped; what is needed is habit of thought, and this can only grow with the lapse of time. His first paper on thermodynamics was published in 1873, two years before the great paper, and the right answer to anyone who complains about the "Heterogeneous Equilibria" is to advise him to spend, like Gibbs, two years over its preliminaries.

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The same qualities appear in the "Statistical Mechanics". There is the same novelty in the initial idea of a *canonical ensemble*, and the same admirably lucid and detailed account of its consequences, leading gently towards the principles of thermodynamics—with at the end a clear perception of the difficulties of radiation. It is always interesting to ask any physicist whether he prefers Gibbs's foundation of statistics or that based on the ideas of Maxwell and Boltzmann. Everyone agrees that an assumption must be made somewhere, but different qualities of mind like to take it differently. Some prefer to follow Gibbs in the conception of the *canonical ensemble*, a very explicit assumption, but one which is not obvious enough to be classed as axiomatic—especially as he uses it in Chap. xv., where the rather abstruse conception of the thermodynamic potential seems to spring complete out of nothing. Others prefer to go behind the *canonical ensemble* by using the *microcanonical*, in which the systems considered all have the same energy and number of atoms. There is no doubt that this idea is more easily grasped and is more plausible, but closer examination shows that it merely conceals the same fundamental difficulties rather more deeply. Gibbs discusses it in one chapter, but his treatment is only really to show that it approximates to the *canonical*. With modern technical methods the *microcanonical ensemble* is as easily discussed as the other, and presents us with the temperature and potentials as obvious mathematical consequences of the calculus; it is tempting to believe that if Gibbs had known of this calculus he would have put the *microcanonical ensemble* in a more prominent position.

These two great works show Gibbs's main character, a capacity for quietly puzzling out a whole field of thought entirely by himself, and getting it into perfect order. That was his main quality, but it was made possible for him by a second quality, and one rather unexpected in a man whose whole work was devoted to natural philosophy. This is a capacity for deep symbolism, and in reading his work we have the feeling that he got more enjoyment out of this mathematical quality than from its physical applications. This is exemplified in the "Heterogeneous Equilibria" by the masterly way in which he handles the variational symbols d, δ, and D (but never ∂). The same mathematical taste comes out even more strongly in his papers on vector analysis, which are the only ones in which any trace of personal feeling appears.

It is one of the perversities of humanity, that we get more excited about notations than about the things they represent. Gibbs's vector notation was attacked by Tait, who championed Hamilton's quaternions with a very undue asperity, and Gibbs's reply, though much more restrained, was largely a counter-attack on Hamilton. The symbolism of vectors has gone through many changes, and even now we can scarcely pronounce a final judgment. The quaternion certainly has a much more limited scope, for though it is better than other methods to deal with rotations, it cannot represent tensors; and it has a brutal directness which must have been repugnant to the symbolic mind of Gibbs. His method, on the other hand, started from the very broad ideas of multiple algebra, and was based on the 'dyadic', essentially a tensor. A few years ago it would have been said that neither of them was the right notation, certainly not the quaternion, and scarcely the dyadic; for, if we want to go beyond the mere idea of vectors, we had better be able to describe tensors of any rank, which can be done admirably by the use of subscript letters. But, curiously enough, in the last year both Gibbs and Hamilton have been reinstated, Gibbs because his notation is that of matrices, which play such a part in the quantum theory, and Hamilton, because the quantities used in expressing the 'spinning electron' have a peculiar quaternion-like flavour and are quite unlike ordinary vectors.

After reading through all Gibbs's works one is naturally drawn to make an estimate of what were the peculiar qualities of the man. A rough dichotomy of great men of science can be made into those who achieve their greatness by understanding things, and those who achieve it because they know what they do not understand. The first type, of which Kelvin was an example, seems to have been born with a direct comprehension of some part of Nature and only has to grow up in order to explain it. The second type works in quite a different way, by puzzling out the things it does not understand. Rayleigh was of this type, and so was Gibbs, and it is interesting to remember that Kelvin did not think much of Gibbs's work. But though we have likened him to Rayleigh, there was a very great difference between them; for Rayleigh wanted to understand anything that turned up, whether it was the general theory of radiation or how much grease there is on clean water, whereas Gibbs was only interested in principles, and undertook the more practical of his works merely in order to convince others that his principles were useful. It is this steadfast study of broad principles that constitutes his greatness.

The Hellenic Society, 1879–1929.

he Journal of Hellenic Studies. Vol. 49. Part 1. Pp. 139 + xcvii + 6 plates. (London: Macmillan and Co., Ltd., 1929.) 21*s.* net.

THE celebration of the fiftieth anniversary of the Society for the Promotion of Hellenic tudies in June last has been made the occasion r the publication of a history of the Society, hich appears as a supplement to the recent sue of the Society's journal. The task of telling ie story could have been entrusted to no more ompetent author than Mr. George Macmillan. He one of the few remaining original members, he cted as honorary secretary from the inception of ie Society until 1919, and is now its honorary easurer; but beyond this the idea of the forma- on of such a society was his, and it was due to m and to Prof. Sayce, with the staunch support Mr. (afterwards Sir) Charles Newton, that the ociety came into being in 1879. Mr. Macmillan had so profited much by the support and advice of M. ennadius, then Minister for Greece in Great Britain. It is perhaps not easy in these days, when cieties seem to spring up with comparatively tle effort, to realise the courage required in the eventies to carry through such an undertaking as ie formation of a society for the study of such a bject as ancient and modern Greek language and lture. Further, the invitation to join the Society as originally issued only to those who had been Greece—not in those days a very large number. hen once it was constituted, however, the com- ittee was to have the power "to elect such other rsons as are interested in its objects". The sponse to the personal appeal issued by Mr. acmillan and Prof. Sayce was immediate and thusiastic, and almost at once the numbers grew beyond their hopes. The early lists of supporters mprise the flower of British classical scholarship; ut the immediate success of the Society and the ise administration of its affairs, which have placed in the front rank of the learned societies of Great ritain, were due to the energy and never-failing thusiasm of Mr. Macmillan, ably seconded by r Charles Newton.

Mr. Macmillan's history of the Society falls into o parts. The first part covers up to the year 04 and was originally written for the twenty- th anniversary. Although this is only reissued order to make the survey of the whole period mplete, it may not be out of place to recall some the activities for which the Society was directly sponsible or with which it has been associated, as a reminder of the debt owed by scholarship to those who have been responsible for its policy and administration. Foremost among such activities is the *Journal of Hellenic Studies*, of which the first volume appeared in 1880. Some anxiety was expressed at the time lest the venture might fail to maintain its vigour after the first interest had died away. These fears were ill-founded. The *Journal* has had among its contributors such men as Schliemann, Colvin, Imhoof Blumer, Sir W. M. Ramsay, Sir Arthur Evans, and D. G. Hogarth, to name only a few—men whose reputations are imperishable while the life and literature of ancient Greece are of account in intellectual culture. Many of the contributions to its pages will be of supreme authority, each in its special branch of study, for generations, and the frequency of the references to the *Journal* in standard works, in classical studies, and in archæology bears witness to its repute.

Among the original purposes of the Society was the publication of copies and photographs of Greek monuments and inscriptions of all kinds. It was also intended to assist travellers and students by providing or arranging for the provision of certain facilities and conveniences in Greece itself. Herein lay the germs of the most useful and fruitful of the activities undertaken by the Society. On one side it came to take an active part in promoting the exploration of the ancient sites of Greece and Asia Minor; on the other, it brought the full weight of its influence to bear on the movement, initiated by Sir Richard Jebb, for the foundation of the British School of Archæology in Athens, and, at a later stage, to assist in founding the sister School of Archæology in Rome. Even before the foundation of the School in Athens in 1886, the Council in 1881 had helped to finance W. M. Ramsay in an archæological expedition to Asia Minor by voting £150 for the expenses of a draughtsman. The results of this expedition encouraged the Council to further efforts, and an Asia Minor Exploration Fund was instituted to carry on the work. This was the first only of a number of funds for similar purposes. Grants were made for work at Naukratis, Thasos, in Caria and on the site of Alexandria. A Cyprus Exploration Fund, established in 1886, was followed by a Cretan Exploration Fund in 1899 under the direction of Sir Arthur Evans, Dr. D. G. Hogarth, and Mr. R. C. Bosanquet. The important results to follow on this last undertaking need no emphasis; but they stimulated the British School to undertake a Cretan excavation of its own at Palaekastro in 1902.

The history of the Society between 1904 and the present year is a record of steady work and expansion stimulated by the discoveries of Sir Arthur Evans in Crete and of the members of the British School both in Crete and on the mainland. The work was sadly interrupted by the War and the Society paid its toll from among its younger members. The special knowledge of the Near East possessed by members of the Society and of the British School was an asset in the Eastern theatres of war, of which full advantage was taken and the nature of which is perhaps only imperfectly realised.

In 1908 the library had grown beyond the capacity of its original quarters in the premises of the Royal Asiatic Society at 22 Albemarle Street, and in the following year it moved to 19 Bloomsbury Square. In 1910–11 the premises were extended to accommodate the offices of the British Schools at Athens and Rome, and, by a wise decision, a common library and collection of photographs and lantern slides for the three bodies was formed. It was not long, however, before this arrangement led to the necessity for still further increase in accommodation, and latterly a house has been acquired in Bedford Square, as is recorded in the Report for 1925–26, where the Society is likely to remain for at least another generation.

In these days, when interest in classical scholarship in the narrower and more restricted sense is thought to be on the wane, the prosperity and growth of the Society for the Promotion of Hellenic Studies may be taken as a gratifying sign that the culture of the Mediterranean, so important in the history of civilisation, still holds its own in the interests of an influential section of the community. We wish the Society an increasingly prosperous and productive future.

The Subject Index to Periodicals.

The Subject Index to Periodicals, 1927. Issued by the Library Association. Pp. x + 299. (London: The Library Association, 1929.) 70*s.* net.

THIS Index was commenced in 1915 as a successor to Poole's Index, which had ceased some years earlier. The present volume sets out to arrange alphabetically by subjects the more important articles in some 600 periodicals, mainly in the English language and of a general character, covering the principal English scientific and technical periodicals, but excluding most of the specialist and semi-technical periodicals and foreign scientific and technical journals. The Index caters only for such inquiries as may be expected to confront a general librarian. From this point of view it is very well done, the get-up is excellent in every way, and, considering the labour of compilation, which is only to be comprehended by those who have undertaken similar work, the price is not high.

The only serious blemish one can find in the work is the system of alphabetical subject headings, devoid of even a rudimentary classification, in which confusion appears in the garb of simplicity. It is doubtful, in view of the intricate network of cross-references required, whether there is any less labour involved in compiling the Index on this principle rather than on a classified system; whilst the labour thrown on to the searcher, who must progress painfully through the tortuous labyrinth of cross-references, is augmented disproportionately. The preface states that the alphabetical headings of the Library of Congress have been used in the main. It would have been advantageous to employ the Library of Congress Classification itself, or, better, a classification which is comprehensive enough to permit periodical literature to be classified—such as the Universal Decimal Classification.

The faults in the Index, which even the most cursory examination reveals, are those that are inseparable from the system adopted, and which no reasonable amount of care on the part of the collaborators could have avoided, namely, the juxtaposition of incongruous subjects, and the separation of related ones. The entry, under the heading "Cells", together with articles on living cells, of a paper on the geometrical properties of space—stackability of tetrakaidecahedra—is reminiscent of the bibliographer's classification of "Lead, kindly light" with "Lead pipes". If one would study the properties of living cells, one finds two papers under "Cells", with cross-references to "Embryology", "Golgi Apparatus", "Karyokinesis", "Plant Cells" and "Tumers", and under each of these headings there are several further cross-references, and so on. Would one investigate the acoustics of buildings; from "Acoustics" there is a reference to "Sound", and vice versa. "Acoustics" leads to "Architectural Acoustics", where one finds eight papers, and to "Music: Acoustics", with no papers. From "Sound" one reaches "Music: Acoustics" again, thence coming back to "Architectural Acoustics", but with a reference also to "Echo", where two more papers are found, though no reference to the Albert Hall echo occurs here. This must be found under "Albert Hall". But a reference to that heading is given under "Architectural Acoustics". This heading also leads to "Buildings: Sound-proofing", with three

papers, and "Church Architecture", with two. Looking for articles on geophysical prospecting, one finds none under "Geophysics", but there is a cross-reference to "Prospecting" where there is one article. This leads to "Electrical Prospecting", with one more, and thence to "Torsion Balance" with another article. There is no reference to a paper on "Applications of sound-prospecting to geophysics", which is listed under "Sound: Propagation". If the subject were more comprehensive, the maze of cross-references would be still more bewildering, leading in the end to the collection of references to the papers of only a single year.

In spite of the system, however, the work should be recommended as a very useful index for the general librarian and for the reader who does not need to exhaust his subject.

S. C. BRADFORD.

Our Bookshelf.

Field and Colliery Surveying: a Text-book for Students of Mining and Civil Engineering Surveying. By T. A. O'Donahue and T. G. Bocking. New and revised edition. Pp. xvi + 327. (London: Macmillan and Co., Ltd., 1928.) 10*s.* 6*d.* net.

THIS book has been reprinted, sometimes with additions and revisions, no less than thirteen times. Past success guarantees the success of an able revision. The size of page of the present edition has increased by some fifteen per cent, and there are fourteen more pages, while much of the groundwork in geometry and mensuration has been wisely omitted to make room for descriptions of improvements in surveying instruments and methods. The original author has been joined by Mr. T. G. Bocking, a surveyor well known not only in practice but also by his important contributions to the periodical press and to the *Transactions* of the Institution of Mining Engineers. Both authors are prominent in the mining profession: both have had experience as examiners; the collaboration is therefore a happy one and is also to be welcomed because, while one author obtained his early experience in the north, the other has had experience both as a civil and mining engineer mainly in the midlands and the south. This revision has purged the book of some localisms of practice and provincialisms of expression.

The book should now be fairly representative of the survey practice in many British coalfields. But it is clearly not a complete exposition, and the only excuse for its sub-title is that it will be useful to pupils of firms styling themselves "Civil and Mining Engineers". The preference of Mr. Bocking for his three-tripod theodolitic outfit is made clear, but this scarcely warrants the extreme brevity of the treatment of the Galletly modification; and his curt dismissal of one-tripod outfits in a few lines is regrettable. His generalisation that "a surveyor should learn to dispense with this additional complication (a centring device) and become experienced in setting up expeditiously and accurately without it" is only valid for three-tripod outfits; applied to one-tripod outfits, it is a case of Bocking *contra mundum*. For such devices abound; every firm of instrument-makers of whatever nationality manufactures them; and they are universally adopted underground and generally for surfacial surveys.

The selected instance of a traverse of 8505 ft. with closing errors of $e_x = -1{\cdot}79$ ft., $e_y = -0{\cdot}96$ ft., $e_z = \pm 0{\cdot}26$ ft. does not prove the excellence of Mr. Bocking's outfit and method, for accidental errors are most commonly mutually destructive, and the most probable aggregate of such errors is zero; what it does show is lack of sympathy with the modern practice of teaching university students to test the performances of instruments from statistics by averaging, or by the method of least squares, and thus more rapidly and surely to arrive at conclusions which the surveyor anciently formed from the impressions of a lifelong experience!

L. H. COOKE.

Probleme der kosmischen Physik. Herausgegeben von Prof. Christian Jensen und Prof. Dr. Arnold Schwassmann. Band 11: *Das Zodiakallicht; sein Wesen, seine kosmische oder tellurische Stellung.* Von Dr. Friedrich Schmid. Pp. x + 132 + 4 Tafeln. (Hamburg: Henri Grand, 1928.) 10·50 gold marks.

THIS excellent series of monographs serves a valuable purpose in providing separate works on many interesting natural phenomena, and not least in the case of those of minor interest, the literature of which is fragmentary and widely scattered; workers in other fields can turn to these books with fair confidence that they will find all the important facts and theories concerning the respective subjects. In particular this is the case with the volume under review, which appears to be almost the first book expressly devoted to the zodiacal light; the author is an enthusiastic student of the subject, and has observed it systematically for nearly forty years. The volume is of great interest both on the side of observation and on that of theory; it may be hoped that it will lead others to observe the zodiacal light regularly, especially since the way in which the position and form of the light vary with the latitude and longitude of the station of observation is not yet adequately known.

The main theoretical question involved in the subject is whether the rarefied matter which, by reflection of sunlight, produces the zodiacal light, is distributed throughout the solar system up to or beyond the earth's orbit, or whether it is merely a terrestrial appendage. The author argues cogently for the latter view; he regards the zodiacal light as the highest and last twilight bow produced by the bending of light in the earth's atmosphere. The theory implies an immense extension of the earth's atmosphere, with an oblateness in a plane

coinciding more nearly with the ecliptic than with the equator, and therefore not explicable merely by the rotation of the outer atmosphere with the rest of the earth.

In the discussion of this part of his subject the author's speculations range rather widely, but the atmosphere presents us with so many inescapable riddles that the addition of one more, relating to its most inaccessible regions, is only in keeping with its character. The terrestrial origin of the zodiacal light is rendered more probable by the existence of a zodiacal light associated with the moon.

The Problem of Motor Transport: an Economic Analysis. By Christopher T. Brunner. Pp. 187. (London: Ernest Benn, Ltd., 1928.) 12*s.* 6*d.* net.

EVERY return of motor traffic in every country shows an ever-increasing number of cars and lorries in use, and though it was only in 1907, as we are reminded by Mr. Brunner, that Mr. Asquith referred to motor-cars as "a luxury which is apt to degenerate into a nuisance", the petrol-driven vehicle is bringing about a change in our modes of travel comparable only to the revolution effected by the railway. Mass production places the motor-car at the service of the man of modest means, and if he cannot afford a car himself, he is a customer of the bus and charabanc owner.

Motor transport problems are therefore always with us, and to those who want a general review of them a better book than Mr. Brunner's would be hard to find. It does not tell the reader how to choose or run a car, but it tells him something about the questions of taxation, traffic, rail and road competition, the economics of special motor roads, why railway companies retain horses, and how roads are maintained. Incidentally, on p. 120 the author tells us that the idea of tarring roads originated with a workman of Hythe, who tarred the road in front of his own house at his own expense. Hythe boasts of being the birthplace of one great pioneer, Sir Francis Pettit Smith—'Screw' Smith—the chief promotor of screw propulsion, and there is a tablet in the High Street to his memory. If Mr. Brunner is correct, Hythe should certainly tell us the name of this workman who has been a benefactor to millions of motorists, and to still more millions of pedestrians.

Das Prinzip der kleinsten Wirkung von Leibniz bis zur Gegenwart. Von Adolf Kneser. (Wissenschaftliche Grundfragen: Philosophische Abhandlungen, herausgegeben von R. Hönigswald, Band 9.) Pp. ii+70. (Leipzig und Berlin: B. G. Teubner, 1928.) 4 gold marks.

THIS pamphlet deals with the principle of least action, chiefly from a philosophical and historical point of view. A few pages are given to the mathematical aspect, which the author, who has written on the calculus of variations, is exceptionally well qualified to discuss. It is often asserted that the principle was due to Maupertuis, but it is here shown that the idea was enunciated much earlier by Leibniz. His arguments were of a theological nature, and might not appeal to present-day scientific workers, but it is remarkable how much of the work of Einstein and others is in the form that Leibniz asserted could be given to every physical law.

Strangely enough, Prof. Kneser, while discussing the use of the principle of least action in the theory of relativity, says nothing of the important part that it has played in establishing the new science of wave mechanics. It was the analogy between the principle of least action and Fermat's principle of least time that suggested an analogy between mechanics and optics, and led de Broglie and Schrödinger to such important results.

H. T. H. P.

The Tragedy of the Italia: *With the Rescuers to the Red Tent.* By Davide Giudici. Pp. viii+216+34 plates. (London: Ernest Benn, Ltd., 1928.) 12*s.* 6*d.* net.

THE author of this book is an Italian newspaper correspondent who was the only journalist on board the *Krassin*, the Russian ice-breaker that took a prominent part in the rescue of the crew of the *Italia* airship off Spitsbergen in the spring of last year. His story is supplemented by accounts of several of the survivors. The *Italia* was wrecked off North East Land on a return flight from the North Pole. The cause of the disaster is not clear, but the result of it was the loss of seventeen lives, including that of Capt. R. Amundsen, who gallantly flew to the rescue, and the expenditure of large sums of money on search expeditions. In these operations the *Krassin* took a notable part. The ship was well handled, but her consumption of fuel, as much as 150 tons a day in open water, limited her sphere of work, and she was unable to force a passage in ice more than about six feet in thickness. In her second voyage, in September, the *Krassin* crossed the unexplored seas north of Giels Land on the way to Franz Josef Land. No new land was found.

Typical Flies: a Photographic Atlas of Diptera. By E. K. Pearce. Series 3. Pp. xv+64. (Cambridge: At the University Press, 1928.) 10*s.* net.

THIS atlas is intended to help the beginner and attract attention to an order of insects the study of which is hampered by the lack of elementary treatises. Like its predecessors, it is essentially a picture book and its object is to illustrate typical British flies by means of annotated half-tone figures. The venation and general appearance of many Diptera are well portrayed by this method, and comparisons with the illustrations should enable the beginner to sort out a considerable proportion of his specimens into their major groups. In the case of the more striking examples, generic or, here and there, specific identifications are also possible. The atlas is uniform with its predecessors, and the standard of execution of the attractive plates is well maintained.

Letters to the Editor.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Diffraction of X-rays by Two-Dimensional Crystal Lattice.

UNDER this title, W. Linnik, of the Leningrad Optical Institute, described in a recent issue of NATURE (April 20) an effect obtained with copper $K\alpha$ radiation and a mica crystal. A narrow beam of X-rays was passed through a cleavage plate of mica, which had previously been heated to redness and cooled. A photograph of the diffracted beam showed a series of spots, the arrangement of which is attributed by Linnik to the action of very thin layers of the crystal as independent *two-dimensional* gratings. It is supposed that "the space effect will be destroyed by the incoherence of waves produced by scattering from incorrectly spaced layers", the heat treatment having broken up the mica into very thin plates without disturbing their orientation. The arrangement of the diffracted beams corresponds to the pseudo-hexagonal network of points at intervals of 5·2 A. in the cleavage plane (001), which is so striking a feature of the mica structure.

I do not think it is necessary to postulate diffraction by a two-dimensional lattice in order to explain Linnik's results; they can be ascribed on the other hand to diffraction of the familiar type by the three-dimensional crystal grating, provided that one may assume the mica to consist of a number of flakes not quite parallel to each other. The normals to these flakes have a random orientation about a certain mean position, though the flakes themselves retain their relative position in the sense that there is no rotation of one flake over another around the mean normal.

To test whether such a structure of the mica plate would produce the effect observed by Linnik, the following experiment was tried by Mr. W. H. Taylor and myself. A cleaved section of muscovite mica, 0·6 mm. in thickness, was set up approximately normal to a narrow beam of molybdenum K radiation. During the exposure of a photographic plate, the section was rotated over a small range around both horizontal and vertical axes normal to the X-ray beam. The effect of this double rotation is to make the normal assume in turn all positions within a small solid angle extending five degrees in every direction from its mean position. The resulting photograph (Fig. 1), while showing more spots owing to the shorter wave-length, has precisely the same appearance as that published by Linnik. There is a complete and fairly uniform series of spots such as would be made by a two-dimensional grating, though in this case the crystal was quite normal and there is no reason to ascribe the effects to anything but the familiar three-dimensional diffraction. When kept stationary the crystal gave a Laue pattern; when heated this was partly replaced by the pattern of Fig. 1, though we did not succeed in obtaining so symmetrical a pattern with the heated crystal as that obtained by Linnik.

This simulation of a two-dimensional grating effect can be readily understood if the mechanism of diffraction is considered. Two of the three conditions for the diffraction of a monochromatic beam are imposed by the spacing of the points on the basal net (the cleavage plane (001)). Thus any diffracted beams which appear must have such positions as are to be expected from this two-dimensional grating. It can readily be calculated that the slight rocking to and fro of the mica does not appreciably affect these positions, a result familiar in the optical grating when the angle of diffraction is small. The third condition for diffraction is achieved by the oscillation of the crystal. Owing to the great length of the c axis (20 A.) a very slight rocking of the crystal (or warping of its surface) will suffice to bring points in successive c planes into such a relative position that reinforcement takes place.

To put this more precisely, when a point on the plate is formed by reflection from the plane (hkl), its

FIG. 1.

position only depends on h and k, being independent of l if second-order corrections are neglected. A rocking of $6\frac{1}{2}°$ in every direction ensures that, for every value of h and k, some plane hkl comes into position for reflection. If h and k are large, many values of l are possible, and the corresponding spot is due to the superposition of several diffracted beams.

It is interesting to follow the changes to be expected as the wave-length is shortened. The spots will crowd towards the centre and form a more and more regular triangular pattern. Each outer spot is formed by the co-operation of a number of planes differing in index l; hence an average between weakly and strongly reflecting planes is struck and the outer spots will be regular in intensity. The photograph will in fact repeat all the features shown in the results of Kikuchi (*Japanese Journal of Physics*, **5**, 2; 1928) on the diffraction of electrons by mica, quoted by Linnik. Its appearance can be readily explained by the familiar laws of diffraction by a three-dimensional grating, assuming a slight random warping of the mica planes. It is not necessary either in the case of electron diffraction or X-ray diffraction to assume that the crystal acts as a two-dimensional grating.

W. L. BRAGG.

University, Manchester,
June 29.

Asymmetry in the Radiation from the Hydrogen Atom in the Electric Field.

IN my monograph "Axialität der Lichtemission und Atomstruktur" (Polytechnische Buchhandlung A. Seydel, Berlin, 1927) I have discussed a case of asymmetry of radiation; if atoms of an element, say of helium, pass through a gas such as hydrogen, under certain conditions for some spectral lines of the moving atoms the radiation in the direction opposite

to the movement is more intense than in the direction of the moving atoms. This phenomenon is one of the facts on which I have based the conclusion that the atoms of the chemical elements have an axial structure and that the emission of light from a single atom is of vortical structure (*Lichtwirbel*) (cf. my monograph "Atomstruktur und Atombindung", Polytechnische Buchhandlung A. Seydel, Berlin, 1928).

Guided by this idea of axiality of atomic structure and emission of light, I have recently discovered an asymmetry in the radiation emitted by atoms in an electric field. Certain lines of the radiation emitted along the axis of a superimposed electric field have different intensities in the two directions of this axis or, more generally, different intensities for the two sides of the plane perpendicular to this axis.

The most important of my observations were made on the hydrogen lines Hα, Hβ, Hγ, and Hδ for the case of the emission along the axis of the superimposed electrical field, and show the following general phenomena.

There are emitted along the axis of the electric field those components of the hydrogen lines which appear electrically normally vibrating to the axis of the field when the axis of vision is normal to the axis of the field. This holds for the components displaced towards the red ('red') and also for the components displaced towards the violet ('violet'); however, the violet components are emitted more intensely in the direction of the field than in the opposite direction, while, on the contrary, the red components are emitted more intensely in the direction opposite to the field than in the direction of the field. This phenomenon explains an observation made independently by Mr. Wierl, that for the line Hγ in the case in which the axis of vision is opposite to the direction of the field, the violet components appear more intense than the red components.

This asymmetry of radiation of the hydrogen atom in the electric field is incompatible with the Bohr-Epstein-Kramers theory and with the Heisenberg-Schrödinger theory of the intensity of radiation of the hydrogen atom in the electric field, as also with the Sommerfeld theorem, founded on this theory, on the symmetry of the hydrogen atom; for these theories require that the intensity of the radiation should be symmetrical to the plane normal to the axis of the electric field. J. STARK.

Grosshesselohe-München, June 28.

The 'Absolute' and 'Relative'.

IT might serve a useful scientific purpose to point out some remarkable anomalies that have resulted from attempts to deduce philosophical conclusions from the findings of pure scientific research. Modern science has as yet no philosophy of its own, but the significance of its great achievements *experimentally* cannot be interpreted legitimately by means of the *speculative* philosophy of the school-men. Much attention has been paid to the general reader by writers who try to explain physical phenomena 'philosophically' without a clearly defined technical vocabulary. That such attempts have been premature and ill-considered is evident by the confusion in the minds of many persons, lay and scientific, as to the future of science.

For example: some statements in NATURE (June 22, p. 954) concerning "Psychological Conceptions in Other Sciences" are so alarming as to cause one to inquire whether it be the intention of workers in pure research to cease work and shut up their laboratories. Even though the conditions that determine quantum 'jumps' cannot be detected by instruments at present in use, are *we* entitled to jump to the conclusion that "structure and entities [now under observation are] in themselves unknowable and unimaginable"? Have we, indeed, reached the limit of possible human knowledge? The remark above cited is prefaced by the statement of Dr. Myers that "with the development of knowledge, ideas of the 'absolute' have been gradually replaced by those of the 'relative'". Further *development* of knowledge seems doubtful if individual entities are in fact unknowable! However, conceptions of 'relativity' appear to dominate the field, at present, to such an extent that one almost questions the sincerity of the search for a unitary field theory to synthesise relative conditions. Is it a really serious quest or merely a competition *pour passer le temps*?

While illogical, this attitude is consistent with the spirit of an age that would repudiate the principle of cause and effect physically as morally. Still, the innate tendency of the human mind to seek for a 'cause' cannot be wholly repressed. Some types of mind feel compelled to account for the behaviour of the blind forces of Nature, regardless of the temporary experimental *impasse*; and they have arbitrarily attributed to these forces a power of choice and self-direction supposed to be exercised by human beings. There is no scientific 'cause' behind the electron! Physical phenomena occur as and when a 'decision' is made by a capricious entity or electron which, like a god of popular mythology, has the power, apparently, to act as it 'chooses' or 'prefers', whatever the environmental conditions. Surely this is suspiciously like absolutism in the sense understood by democratic entities?

To speak, however, of having 'ideas about the absolute' is one of the many contemporary illustrations of a contradiction in terms. To conceive it possible to form *any* idea to represent the absolute is the cardinal error of theological and idealist philosophies the absolute deity of which is a decidedly relative individual discarded by science some generations ago.

In the article (NATURE, June 1 and 8), "Einstein's and other Unitary Field Theories: An Explanation for the General Reader", Prof. Piaggio refers to Newton's belief in absolute rotation. As the great Newton cannot have been an illogical thinker, it should be worth while to examine the basis of this belief. We who function in finite, relative matter are unable, obviously, to contact, record, or describe an infinite, absolute energy, if such there be. But, though we cannot imagine a state of rotation *per se*, physics, to be logical, must postulate a perpetual, self-generating motion as the uncreated, causeless cause of known and knowable material velocities. *In-finite* (without end or beginning), *when ascribed to energy, means ceaseless*, that is *without intervals*—a state that cannot be conceived mentally but, nevertheless, a logical and necessary hypothesis. For, if there be no such absolute perpetuity or infinity, how do relative conditions come into existence and how are they maintained in their interrelated activities?

While research is inducing a greater respect for the scientific knowledge of former ages, no investigation has been made by science into the philosophical rationale of the ancient arts of alchemy, astronomy, medicine, psychology, etc. Consequently, we attribute ideas of popular religions to the ancient scientific philosophers whose only deity was absolute motion. "Everything is full of gods," Thales said, because 'gods' and 'atoms' were synonymous terms. It is possible that there may be renewed appreciation of Newton's science when his philosophy is understood.

W. W. L.

June 23.

New Fixatives for Plant Cytology.

FOR the study of somatic chromosomes a fixative is required that penetrates quickly, but does not shrink the cytoplasm; that spreads the chromosomes for counting, and gives clear definition of constrictions and trabants. Carnoy spreads the chromosomes out well, but most of the definition is lost. Flemming and its modifications are most useful, giving very good results, but there are some plants for which they are not suitable. Some plants, however, cannot be fixed well by any of our present methods.

In the course of work with *Primula sinensis* a number of fixatives were tried, among others the following new formula, which was found to give excellent results:

1 per cent Chromic acid	90 c.c.
Potassium bichromate	1 gm.
Sodium sulphate	0·5 gm.
Urea	1 gm.
5 per cent Glacial acetic acid	10 c.c.
2 per cent Osmic acid	15 c.c.
Distilled water	45 c.c.

The method employed is similar to that used with Flemming solution. Material is immersed in the solution for several minutes under an air pump to remove air and to aid penetration, and then it remains in the solution for a further twelve hours. After embedding in paraffin, cutting and mounting in the usual way, the slides are bleached in 1 part hydrogen peroxide in 10 parts 70 per cent alcohol for two to three hours. They are then placed in an iodine solution for a minute or two to remove any remaining bichromate. Material can be stained with gentian violet (Newton's method), hæmatoxylin, or other cytological stains in common use.

Excellent results have been obtained with *Papaver*, *Melandrium*, *Datura*, and *Pentstemon lævigatus* (with 96 chromosomes), and a comparative test of several fixatives, namely, Zenker, Flemming, Kihara, Navashin, and Allen's Bouin upon *Matthiola* ovaries, favoured my fixative both in regard to penetration and spreading of the chromosomes. For *Pisum* pollen mother-cells, whole buds are fixed in Carnoy for about 30 seconds; the Carnoy is then poured off and the fixation continued in the above fixative. This method is similar to Kihara's.

Although not used extensively on pollen mother-cells, the fixative has given good preparations by the smear method. The following, however, was found better for *Matthiola* pollen mother-cells:

1 per cent Chromic acid	90 c.c.
Potassium bichromate	3 gm.
Sodium sulphate	1 gm.
Urea	1 gm.
2 per cent Osmic acid	20 c.c.
Distilled water	50 c.c.

A third fixative used successfully with the smear method for pollen mother-cells is a mixture of Allen's Bouin and Champy in equal proportions. This was found useful for *Campanula* and *Solanum* species. The smeared slides, after washing and taking up through alcohols, must be left from two to three hours in a saturated solution of lithium carbonate in 70 per cent alcohol to remove any remaining picric acid.

L. LA-COUR.

An Isotope of Carbon, Mass 13.

THE bands belonging to the Swan spectrum of carbon appear in the vacuum electric furnace at about 2400° C. At temperatures above 2600° they are strong and clear-cut, even the band at λ6191, difficult to obtain in the carbon arc, being well defined. It has been noted by one of us, during a variety of electric furnace investigations, that plates on which the band at λ4737 is very strong showed a faint band, not to be ascribed to a ghost, about 7·5 A. to the red of the strong band. The carbon arc shows a scattered structure in this region, which is suppressed in the furnace. It has, however, thus far failed to give the faint band, which in the furnace spectrum shows a distinct structure, essentially identical with the structure of the main band.

The recent discovery of isotopes of oxygen makes it very probable that other similar elements contain isotopes in small quantities. We have accordingly measured this faint band very carefully, using a first order exposure of a 15 ft. concave grating, the furnace being at about 2800° C. It is now generally agreed that the Swan bands are due to the neutral C_2 molecule, presumably $C^{12} - C^{12}$. We find that the new faint band corresponds quantitatively to that which should be given by an assumed $C^{13} - C^{12}$ molecule. The constants of the Swan band system are known with great precision ("Int. Crit. Tables", **5**, 411, and J. D. Shea, *Phys. Rev.*, **30**, 825; 1927), and an accurate comparison with theory is therefore possible. With data of the precision now becoming available for oxygen, as well as in the present case, it is necessary to avoid various approximations which have commonly been used in previous work on isotopes. This will be fully discussed in later publications.

Because of irradiation due to the strong band, it is to be expected that the measured distance between the two *heads* will be slightly *smaller* than the calculated isotope shift for the head. This is in fact the case, this distance being measured as 2·020 mm. (= 7·520 A. = 33·44 cm.$^{-1}$) as compared to a calculated isotope shift of 2·028 mm. (33·58 cm.$^{-1}$). Fortunately, however, it is possible to distinguish six individual lines in the very faint isotope band. These have been identified as the unresolved triplets P_{26} to P_{31} (Shea's nomenclature). In the comparator P_{30} and P_{29} could be measured with reasonable accuracy, P_{28} and P_{27} less reliably, P_{26} very poorly, and P_{31} not at all. The corresponding triplets in the main band (also unresolved) could be measured with great precision. The observed isotope shifts in millimetres for P_{30} to P_{26}, with the calculated in parenthesis in each case, are 2·059 (2·0515), 2·049 (2·0473), 2·037 (2·0429), 2·033 (2·0395), and 2·044 (2·0373) respectively. Multiplication by 16·58 gives the shift in cm.$^{-1}$. The two good lines (P_{30} and P_{29}) give an average measured shift 0·082 cm.$^{-1}$ too large. Although with the present available data the fact may have no significance, it is interesting to note that this small discrepancy may be cancelled by assuming 12·0000 and 13·0026 for the two masses.

This 1-0 band (λ4737) is especially favourable for showing the faint isotope molecule, when one considers photographic intensity, position with respect to other bands (particularly CN), and size of the shift. We shall endeavour to get better plates, showing the isotope effect in other bands, and also showing more detailed fine structure. The present evidence seems, however, fully sufficient to establish the existence of an isotope of carbon, of mass 13. We cannot at this time make any statement as to its relative abundance, except to say that the isotope band is hundreds of times as faint as the strong band.

ARTHUR S. KING.

Mount Wilson Observatory,
Carnegie Institute of Washington.

RAYMOND T. BIRGE.

Physical Laboratory,
University of California,
June 24.

A Spinning Target X-ray Generator.

IT is a well-known fact that the energy density, that is, the energy per unit time and area in the focus of an X-ray tube, cannot be raised indefinitely owing to the extreme heating and consequent deterioration of the target surface. The input limit has been calculated for the usual type of X-ray tube in a previous paper (*Proc. Roy. Soc.*, A, vol. 117, p. 30; 1927).

In many applications of X-rays it would be very valuable to work with higher energy densities than those which had been used so far. This requires a method of removing the heat more radical than has been hitherto adopted. A simple way for doing this is

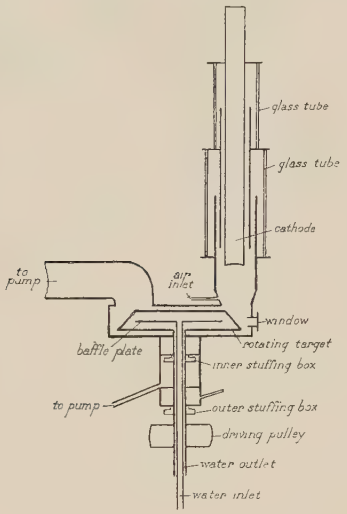

FIG. 1.

to produce the focus on the periphery of a rotating disc. The theoretical discussion which will shortly appear shows that the input limit can be raised as follows:

$$W_{\substack{\text{max.}\\\text{rotating}}} = W_{\substack{\text{max.}\\\text{rest}}} \times \sqrt{\delta \cdot \frac{\rho \cdot c}{k} \cdot v}$$

where $W_{\substack{\text{max.}\\\text{rotating}}}$ = maximum input for a rotating target, $W_{\substack{\text{max.}\\\text{rest}}}$ = maximum input for a target at rest, c specific heat of the anticathode material, k thermal conductivity, ρ density, δ radius of the focus in cm., v velocity of the target at the focus. This equation only holds if the expression under the square root is large compared with unity.

The use of the rotating disc avoids excessive local heating, but it is still necessary to remove the heat from the cathode as a whole, and this can be done by a water-cooling system.

An experimental X-ray plant embodying these principles of design has been built in the Davy-Faraday Laboratory. The target of the generator as shown in the diagram (Fig. 1) consists of a hollow copper disc with a bevelled surface on which the cathode rays impinge at about 5·5 cm. distance from the centre of the disc. The disc is mounted on a hollow shaft and rotates with about 2000 rev. per min. The cooling water is fed into the hollow target through a small tube inside the shaft and is directed against the inner cooling surface of the target by a baffle plate. The outlet is formed by the concentric space between the inlet tube and the inner wall of the driving shaft. The generator is permanently connected to a high-speed pump, and the pressure is regulated by a needle valve. The maximum input which the generator should stand according to calculations is about 5 kilowatts with a focus of 1 mm. diameter.

The generator was first tested on a high-tension plant which consisted of two large induction coils capable of standing an input of more than 20 kilowatts and operated by a specially constructed Wehnelt interrupter. The peak potential, judging from the spark gap, varied between 30 and 100 kilovolts. On one occasion, the input in the primary circuit being then about 30 kilowatts, a groove was cut in the disc of about 1 mm. width showing that a sharp focus must have been obtained in this experiment. Measurements of the actual energy striking the target were not made in this preliminary test. The X-ray energy must have been considerable, and visual observations of powder rings and of patterns due to reflections by a single crystal could be made on a fluorescent screen quite easily.

A second test was carried out at lower voltages, using this time a completely rectified supply. The generator ran very steadily at 25,000 volts and 100 milliamperes; at 19,000 volts and 200 milliamperes the discharge began to be unstable. This was possibly due to the heating of the cathode, the cooling of which depended entirely upon radiation in these preliminary tests.

I have been assisted in this work by Mr. R. E. Clay. A detailed description of the generator will be given later. I wish to express my thanks to the G.E.C. Research Laboratory in Wembley for letting me use their large high-tension D.C. plant.

ALEX. MÜLLER.

Davy-Faraday Laboratory,
Royal Institution,
June 27.

The Origin of Variations.

AN article by Sir Oliver Lodge, dealing with the extracts from the Hooker Lecture on "The Origin of Adaptations" which were published in the issue for June 1 (p. 841), appears in the issue for June 29 (p. 982). It is very gratifying that the lecture has aroused the interest of so distinguished a physicist, and I can assure him that all biologists will welcome his intervention and value the analysis of their problems to which he has given expression. With much of his article I am in full agreement, and for the rest, two quotations will perhaps most briefly make my position clear. The first has appeared on the title-page of every issue of NATURE since its first number was printed in 1869:

"To the solid ground
Of Nature trusts the mind that builds for aye."
—WORDSWORTH.

The second, in lighter vein which Sir Oliver Lodge with his keen sense of humour will appreciate, is from Prof. Eddington ("The Nature of the Physical World", p. 21):

"It does not seem a profitable procedure to make odd noises on the off-chance that posterity will find a significance to attach to them."

The course deprecated by Prof. Eddington seems to be the very one which Sir Oliver Lodge advises biologists to follow. With Wordsworth's lines he will, I imagine, be willing to express agreement, and they have this advantage that, perforce, he must abstain from making square-bracketed insertions which would upset the poet's rhythm, to say nothing of changing his meaning.

E. J. ALLEN.

Marine Biological Laboratory, Plymouth.

In a stimulating article in NATURE of June 29, 982, Sir Oliver Lodge makes the following statement: We know, however, that [germ-plasm] is modifiable y slight changes in environment." Apart from the uestion whether we can in reality separate germ-plasm rom soma, and excluding cases of injury, I suggest hat we do not know this. Do we even know for cer-ain that the soma itself can be changed ?

In a few cases it is claimed that changes in soma ave been brought about by an alteration in environ-ient, and even that those changes are capable of being ransmitted from parent to offspring. Without ttempting to touch upon the question of the inherit-nce of acquired characteristics, I would yet point out hat for every single case where environment has been ntentionally changed and its effect noted, there are housands of cases in Nature where change of en-ironment has failed to produce any apparent modi-ying effect.

Personally, I do not think that there is much diffi-ulty in accounting for the absence of the influence of hange in environment, for I believe that any such nfluence can be selective only. Environment may be ll-important as a selective influence, but as such that nfluence must be definitely restricted. Perhaps this onception may be made clearer by reference to a mple concrete example. Given an ordinary dice, ne can turn it up several ways and thus select several umbers, but they can only range from one to six. iven the power of changing the numbers, however, nd the range of selection becomes infinite. No one ould deny the selective influence of environment, but believe that its *modifying* influence has yet to be emonstrated.

A. G. LOWNDES.

Marlborough College, Wilts.

Production of High Lo Surdo Fields.

IT has already been reported in this journal (NATURE, ug. 25, 1928, p. 277) by one of us, that the field trength in a Lo Surdo tube may be increased con-

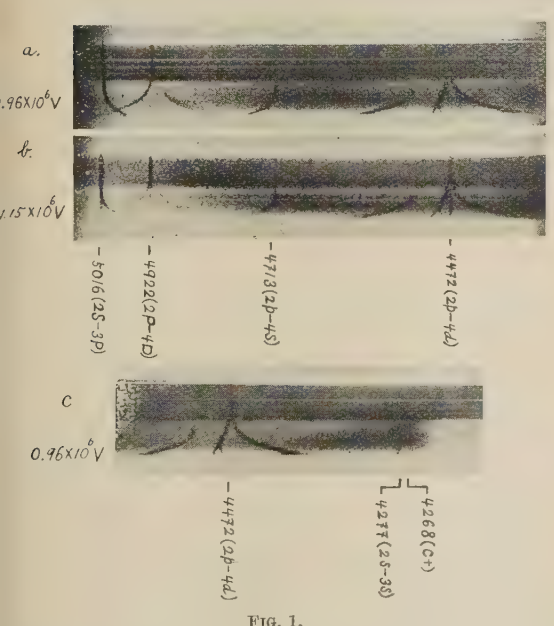

FIG. 1.

derably by the simple device of using proper periodic npulses as the terminal supply. Since then the xperimental arrangement has been improved so that a steady discharge may be maintained in a capillary tube the inner diameter of which is as small as 0·5 mm. for two or three hours. First, the volume of the discharge tube was increased to more than 20 litres; and secondly, only the half wave was used by taking off some of the vanes of the synchronous motor rectifier. Finally, the induction was removed from the secondary circuit. In this way the maximum voltage attained was roughly 1·2 million volts per cm.

The accompanying photographs (cf. Ishida and Kamijima: Sc. Pap. I.P.C.R. **9**, p. 118) were taken by a small Fuess spectrograph. The undeflected lines in photograph *b* are the superposed zero lines. The following points may be noted:

1. The lines λλ5016 and 4922, which barely touch each other at a field of 550 kv., here cross decidedly.
2. The shorter wave component of the line λ4472 turns back to the zero line in photograph *b*, whereas the longer wave component keeps its original direction.
3. The line λ4268 of ionised carbon is deflected to the negative side.

YOSHIO ISHIDA,
SHIGERU HIYAMA.

The Institute of Physical and
Chemical Research, Tokyo, Japan.

New Bands in the Spectrum of Oxide of Lanthanum.

A SMALL portion of the spectrum of oxide of lanthanum has been known for some time. The most notable of the old measurements (v. Kayser, "Handbuch der Spektroscopie", Bd. 5, p. 666, Leipzig, 1910) refer to two groups of bands in the violet at λ4418 and λ4372, and to a pair of bands in the green at λ5600 and λ5626.

R. Mecke (*Naturwiss.*, **17**, 86; 1929) identified and measured seven groups of bands recently at λλ4372, 4418, 5600, 7380, 7403, 7877 and 7910, and Auerbach (*Naturwiss.*, **17**, 84; 1929) identified other bands in the spectrum between λ7876 and λ8638.

The spectrum of oxide of lanthanum has usually been obtained by means of the electric arc; Hartley was the only one who used the oxyhydrogen flame. But the spectra so obtained are incomplete because the necessary conditions in order to volatilise perfectly the oxide of lanthanum have never been attained. It either decomposes almost completely into metal and oxygen, or it remains partially as a very fine powder.

By means of a simple arrangement of the oxy-hydrogen flame, I have been able to vaporise the oxide completely. The spectrum emitted in this state shows bands only; there are no lines or continuous background.

The spectrum has been photographed with a quartz spectrograph between λ7000 and λ2400, and shows groups of bands at λλ6540, 6154, 5866, 5600, 5380, 5178, (5058), 4582, 4543, 4531, 4418, 4372, 4357, 3708, 3671, 3620, 3612, 3566. The groups between λ6540 and λ5058 are all composed of double-headed bands; the separation of the double heads decreases from group to group as the wave-length decreases.

It is interesting to note that the presence of various bands in the ultra-violet region of the spectrum has now been established; their existence had been predicted by R. Mecke as the result of his investigation of the bands in the green and red.

GIORGIO PICCARDI.

Istituto di Chimica generale
de la R. Università,
Via Gino Capponi 3,
Firenze, June.

Recent Progress in Canadian Hydro-Electric Power Development.

By Dr. BRYSSON CUNNINGHAM.

IT is just about two years (*vide* NATURE, Aug. 27, 1927, and Sept. 3, 1927) since, on my return from a round of visits to some of the principal waterfalls and generating stations in eastern Canada, I described the situation in the Dominion as regards the development of its water resources for power purposes. It will probably be of interest at this stage to recount the progress which has been made during the intervening period, particularly as it continues to be of a very notable and far-reaching character. The statistics used for the purpose and the tabular information incorporated in this article have been derived from recent reports issued by the Water Powers Branch of the Canadian Department of the Interior.[1]

In order to appreciate fully the importance of water power development in Canada, it is necessary at the outset to bear in mind two salient facts; first, that the Dominion as a whole, and particularly its two chief industrial and manufacturing provinces, Quebec and Ontario, are very favourably endowed with abundant natural sources of water power; and secondly, that these same two provinces are singularly lacking in geological deposits of coal. Distinguished as the Acute Fuel Area, the two provinces, comprising the bulk of the population and the predominant share of commercial, mining, and manufacturing interests, would be lamentably crippled in their activities were it not for the fortunate compensation. Water power, therefore, is an essential feature of the industrial development of the Dominion.

In Great Britain, developable water power supplies are relatively meagre and of an insignificant order. Estimates of the aggregate are somewhat varied and range up to a million horse-power or perhaps slightly more. In Canada, although there are important regions incompletely surveyed and imperfectly scheduled, fully forty million horse-power is now definitely located and accounted for, and of this about 5½ million h.p. has been actually developed up to the present time. It is true that the developed horse-power amounts to little more than 13 per cent of the estimated available total, yet it is greatly in excess of anything realised or even realisable in Great Britain. Moreover, it is steadily increasing at a rapid rate. Less than five years ago the total of developed horse-power was only 3½ millions; nine years ago, 2½ millions; and in 1900, less than a quarter of a million. If we take the rate of progress (nearly 500,000 h.p. per annum) which has obtained during the last five years, another decade will suffice to see more than ten

FIG. 1.—Hydro-electric installation (540,000 h.p.) at Isle Maligne, Lake St. John, Province of Quebec. (By courtesy of the High Commissioner of Canada.)

[1] No. 1227, Water Power in the Mineral Industries of Canada. No. 1231, Water Power in the Pulp and Paper Industry of Canada. No. 1242, Hydro-electric Progress in Canada during 1928. No. 1253, Water Power Resources of Canada.

illion horse-power in operation. Fig. 1 illustrates single development of 540,000 h.p. carried out thin a period of five years.

From the economical point of view, the present hievement and its future possibilities are specially oteworthy. It has just been pointed out that the ovinces of Ontario and Quebec, covering an area well over a million square miles, are practically stitute of internal coal supplies, and are dependent external sources for mineral fuel. On a reason-le computation under existing conditions, each stalled water horse-power is the equivalent of tons of coal per annum. This means that at e present time there is a saving in coal consump-554 per thousand. In certain provinces the ratio is much higher; for example, in British Columbia it is 952, and in Quebec 902. In Yukon and the North-West Territories, where the population is scanty and there are heavy demands for power for low-grade gold mining, the figure is as high as 1039.

Perhaps a fairer and more apposite comparison would be with the United States, where, reduced to the same basis of computation (ordinary six months' flow and 80 per cent turbine efficiency), the developable horse-power may be put at about 60 millions. The quantity actually developed at the present time is $13\frac{1}{2}$ millions, equivalent to 127 per thousand of the population.

Fig. 2.—Two hydro-electric power stations on Gatineau River, Province of Quebec. Farmers' Rapids (120,000 h.p.) in foreground; Chelsea Dam (170,000 h.p.) beyond. (By courtesy of the High Commissioner of Canada.)

n in Canada of no less than 33 million tons—a narkable quantity. In districts with coal readily ainable by mining, the consideration to industry significant enough; where coal has necessarily be imported, it is vital.

The only European countries which compare h Canada in intensity of water power develop-nt per head of population are the Scandinavian gdoms and Switzerland. Norway, Sweden, and tzerland are each much smaller in area, have aller populations, and are less industrially loited. In the return published by the U.S. logical Survey in January 1927 (the latest res which I have at hand) the developed er horse-power of Norway is given as 717 per usand of the population, of Sweden as 223 per usand, and of Switzerland as 476 per thousand. the present time the average for Canada is

Table I. below shows the available and developed water power in the respective provinces of the Dominion of Canada as determined to Jan. 1, 1929. Compared with the similar table to January 1927, published in Nature in August 1927, there is an increase of nearly two millions in the available 24-hour horse-power at ordinary minimum flow, of more than one million horse-power for the same 24-hour period at ordinary six months' flow, and of rather more than three-quarters of a million in the horse-power of actual turbine installations. It will be noted that the provinces of Ontario and Quebec possess more than 60 per cent of the available power and more than 80 per cent of the installed power.

Comparison of the corresponding figures for available horse-power at ordinary six months' flow with those of turbine horse-power at sites where

generating plant is actually installed, shows the turbine installation to be 30 per cent in excess of the scheduled available quantity, and this has proved to be good commercial practice. Hence, it is reasonable to apply a similar percentage

TABLE I.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA.

Jan. 1, 1929.

Province.	Available 24-hour Power at 80 per cent Efficiency.		Turbine Installation, H.P.
	At Ordinary Min. Flow, H.P.	At Ordinary Six Months' Flow, H.P.	
British Columbia .	1,931,000	5,103,500	554,792
Alberta . .	390,000	1,049,500	34,532
Saskatchewan .	542,000	1,082,000	35
Manitoba . .	3,309,000	5,344,500	311,925
Ontario . .	5,330,000	6,940,000	1,903,705
Quebec . .	8,459,000	13,064,000	2,387,118
New Brunswick .	87,000	120,800	67,131
Nova Scotia . .	20,800	128,300	74,356
Prince Edward Island . .	3,000	5,300	2,439
Yukon and North-west Territories.	125,200	275,300	13,199
Canada . . .	20,197,000	33,113,200	5,349,232

addition to the total of 33,113,200 at the foot of column 3, bringing it up to about 44,000,000 and justifying the use earlier in this article of the estimate of "fully 40 million horse-power" as definitely located up to the present.

The figure of 5,349,232 given as the total turbine installation horse-power to Jan. 1 last takes no account of a number of large installations which were nearing completion about that date, or of a number of others which were in the initial stages of development. It is estimated that these uncompleted undertakings will add something like 1,200,000 horse-power to the total, and there is every prospect of further important enterprises being begun. For example, the Gatineau Power Company placed six large units of generating plant, each of 34,000 h.p. capacity, in operation at their Paugan Station on the Gatineau River in September last, with provision for two additional units of the same capacity. The same Company was simultaneously installing a fourth unit at each of two other stations lower down the Gatineau River, namely, at Chelsea and Farmers' Rapids (Fig. 2). These new units were so far advanced as to be expected to be in operation early this year. At Chute-à-Carron, on the Saguenay River, works are in progress for an initial installation of four units each of 65,000 horse-power, and these are under contract to be completed by July 1931, to be followed by additional units of an aggregate of about a million horse-power.

So much for the sources and extent of generation. It will be interesting now to consider the ultimate application of this vast accumulation of motive power. There are three main sources of absorption; first, the central electric station for general and municipal purposes; secondly, the pulp and paper industry; and lastly, miscellaneous industries, including mining. The first requires little or no comment. The central station is a characteristic and outstanding feature in modern civilisation; from it radiate supplies of electricity for domestic and street lighting, for power, heating, traction, and numerous uses of various kinds. The pulp and paper industry is Canada's chief manufacturing activity. The gross and net values of production and the disbursements in salaries and wages in this industry are greater than those of any other Canadian industry, while the national output of newsprint, that is, paper prepared for the newspaper printing press, during the last completed census year exceeded that of any other country. Some of the power required for the purpose is generated directly at the mills from a local water supply, in other cases it is taken by purchase from a central station; jointly, the quantity utilised in the industry is 25 per cent of the whole output of the Dominion. As regards the mineral industries, it can be said that the profitable operation of many

TABLE II.

DEVELOPED WATER POWER IN CANADA.

Distribution by Industries and Per 1000 of Population.

Jan. 1, 1929.

Province.	Turbine Installation in H.P.				Population, June 1, 1928.	Total Installation per 1000 Population, H.P.
	In Central Electric Stations.	In Pulp and Paper Mills.	In other Industries.	Total.		
British Columbia	412,960	81,000	60,832	554,792	583,000	952
Alberta	34,320	..	212	34,532	631,900	55
Saskatchewan	..	..	35	35	851,000	0·04
Manitoba	311,925	..	..	311,925	655,000	476
Ontario	1,568,423	240,880	94,402	1,903,705	3,229,000	590
Quebec	2,030,850	220,810	135,458	2,387,118	2,647,000	902
New Brunswick	43,910	14,278	8,943	67,131	415,000	162
Nova Scotia	42,929	16,008	15,419	74,356	547,000	136
Prince Edward Island . .	376	..	2,063	2,439	86,400	28
Yukon and North-west Territories .	..	..	13,199	13,199	12,700	1,039
Canada	4,445,693	572,976	330,563	5,349,232	9,658,000	554

of the Canadian mines is only made possible by the low cost at which ample supplies of power can be obtained from hydro-electric sources. Fuel power would in many cases be prohibitive. It is affirmed in one of the Government reports that without the aid of water power the mining industry of Canada could not have approached its present magnitude.

Table II. shows, as at Jan. 1, 1929, the distribution of developed water power in Canada under the three heads detailed above. Column 2 in the table includes only hydro-electric stations which develop power for sale. Columns 3 and 4 comprise the power specifically generated for the industries in question. As explained above, additional and large supplies of power are obtained by purchase from the central stations.

It is interesting to note that the total outstanding capital invested in water-power developments represents an average of 219 dollars, or about £44 per horse-power installed, including transmission and distribution—quite a low figure compared with that of other countries under similar conditions.

Fully to describe and expound the striking figures collected and published by the Canadian Government would require much more space than can be allocated to the subject here. They are eloquent of vigorous progress and unflagging enterprise. To the ordinary reader they are full of interest; to the observant visitor they are a confirmation of impressions received from numerous striking spectacles; and to the scientific inquirer they open out a vista of wonderful possibilities for a country which is yet on the threshold of its career.

The Original Home and Mode of Dispersal of the Coconut.

By Dr. ARTHUR W. HILL, C.M.G., F.R.S.

THE origin and mode of dispersal of the coconut, which is now widespread throughout the tropics of the Old and New Worlds, has long been a subject of discussion. De Candolle, Beccari, Chiovenda,[1] and others consider the coconut originated in the Indian Archipelago or in the Pacific Islands, while O. F. Cook[2] attempts to prove that its origin was in the valleys of the Andes of Colombia in South America and that it was transported thence, entirely by human agency, far and wide across the tropic seas. H. B. Guppy[3] also holds the opinion that the home of the genus *Cocos* is in America, while Geoffrey Smith[4] states, on information given him by Mr. Hedley of Sydney, that the coconut was introduced to the Pacific Islands from Mexico by Polynesian mariners. Cook asserts that it is highly improbable that sea-borne coconuts could ever be cast up on a shore in such a favourable position that they could germinate without the aid of man, and Schimper[5] considers that the coconut groves "fringing most tropical coasts have only exceptionally originated without human aid". The fact remains, however, that coconuts are the common strand palms on almost every tropical island and that they were found well-established when many of these uninhabited islands were discovered.

Another fact which lends support to the original home of the coconut being the Indian Archipelago or Polynesia is the great variety of the coconuts now found in the East. Many of these varieties have well-marked characteristics such as colour of the nuts, thickness of the husks, etc., and many of these special kinds are grown specially for religious ceremonies among the Hindus, which also points to the palm being of great antiquity in South India. The hereditary occupation of the Tiyans of the Malabar Coast also is the tapping of coconuts for toddy.[6] Then, again, the Tamil and Malayalum name for the coconut is *tengai* (*ten* = south, *kai* = fruit), that is, the fruit which comes from the south.

Chiovenda[1] (l.c. pp. 397-399) quotes a reference to the coconut in Indian medical literature, supposed to date back to 1400 B.C., and a statement of Ctesia that coconut oil was in common use in India in 400 B.C. He cites evidence that the coconut was widely cultivated in the Gangetic Plain in the first century of the Christian era, and refers also to two Arabian travellers, Abu Said and Ibn Wahab, who in the ninth century went as an envoy to China and reported that the Laccadive and Maldive Islands were covered with coconut palms, which appeared to be indigenous there. One of these travellers also made the interesting statement of the existence in India of a religious sect, which, for humanitarian reasons, introduced and propagated the coconut on those islands where it did not already exist.

The name 'coco' appears to be due to the Portuguese,[7] and they were made acquainted with the palm from their voyages in the East. The commonest word in the languages of the Pacific for the coconut is some form of the Indonesian

[1] Beccari, O. *Ann. Jard. Bot. Buitenzorg*, Supp. 3, pt. 2, 1910, pp. 799-806, and Malesia, I., p. 86. Chiovenda, Emilio, *Webbia*, vol. 5, pt. 2, pp. 359-449 (1923).

[2] Cook, O. F. *Contrib.* from U.S. Natl. Herb., **2**, p. 257 (1901), and also "History of the Cocoa-nut Palm in America", *Contrib.* from U.S. Natl. Herb., **14**, pt. 2, pp. 271-342 (1910).

[3] Guppy, H. B. "Observations of a Naturalist in the Pacific", vol. 2, 1906, pp. 67, 413.

[4] Smith, Geoffrey. "Cambridge Natural History", Crustacea, pp. 173-175.

[5] Schimper. "Plant Geography", Eng. ed., I., p. 231.

[6] See Sampson, H. C. "The Coconut Palm", 1923, p. 74 *et seq.*

[7] "The Simples and Drugs of India", Garcia Da Orta (1563), translated by Sir Clements Markham, p. 139; also "Roterio", Vasco da Gama (1498) and the book of Barbosa (1516).

Garcia da Orta generally spells the name *coquo*: "We, the Portuguese," he writes, "with reference to those three holes, gave it the name of Coco (Spanish *macoco*, for monkey-faced), because it seems like the face of an ape or other animal." With regard to other names, he says the palm is called Maro and the fruit Narel, and this word Narel is common to all, for it is used by Persians and Arabs (*narikela* Sanskrit, in Persian *nargila*, a name given to the 'hubble-bubble', or Indian smoking stand-pipe, from the shell of a coconut being generally used to contain the water through which the smoke from the tobacco bowl is sucked through a long, flexible serpentine pipe; and *nari-kela* simply means 'water spring' or 'squirt').

"Avicenna calls it Jauzialindi, which means 'nut of India' (Jauzulhindi, the Indian nut). Serapio and Rasis call the tree Jaralnare, which means 'the tree that yields Coco' (Jaralnari, the Naril tree). The Malabar people call the tree Tengamaram (the Southern Tree, *i.e.* introduced from Ceylon), and the fruit when it is ripe Tenga. The Malays call the tree Tricam (Trinarajah, 'King of Grasses,' is a Sanskrit name for the coconut palm), and the coconut Nihor."

It is also of interest (l.c. p. 141) to note that the word 'coir' comes from the Malabar Kayiru, the fibrous rind of the coconut (see also Watt, "Dictionary of the Economic Products of India").

niur (*niu*, *nu*), and everything points to these names being of great antiquity, thus lending additional support to the coconut belonging to this part of the world. Mr. S. H. Ray, in a letter to me on the matter, suggests that the fact of the coconut having other names among the Papuan and Melanesian peoples and traces of others in Indonesia seems to point to it being indigenous in the Islands.

In connexion with the Polynesian Islands being the original home of the coconut palm, Beccari (l.c. pp. 804-806), lays stress on the occurrence of the robber crab, *Birgus latro*, in these Islands. This remarkable crab is able to break open the coconut shell with its heavy chelæ by hammering with them on the 'eye hole' until a large enough opening is made for it to insert its small chela in order to extract the pulp or endosperm.[8] It also ascends the palms for the purpose of getting the nuts, and is said to put its abdomen into the shell and carry it about with it as a protection. Another interesting point suggesting that the association of the robber crab and the coconut must be of great antiquity is afforded by the fact that the crab uses the husk of the nut for lining its burrows. Beccari considers this association of the crab with the coconut affords further support to the view that the coconut originated in the Polynesian region. Geoffrey Smith, however, does not believe the association of the *Birgus* with the coconut is of very ancient origin, possibly because he accepted the information given him by Mr. Hedley, that the coconut was introduced to the Pacific Islands from Mexico by Polynesian mariners.

Although there is this remarkable association between the crab and the coconut, it is only right to point out that the crab is found on islands where there are no coconuts and vice versa, also that the crabs are commonly found on the fruit clusters of *Pandanus*, the screw pine, the individual segments of which are much chewed and squeezed by the crab.

F. W. Christian[9] gives the names *kuku* from Rarotonga and the Gilbert Islands and *kukuma* in the Marquesas for the robber crab, and also quotes the Arabic *khukum* (a crab), and the Maori *kuku* (to nip). These names suggest a possible connexion with the Portuguese *coco*. Dr. C. O. Blagden, however, who has kindly looked into the matter, has sent me the following letter, which shows that there are no grounds for connecting the name 'coco' with any native names of the crab.

> On the face of it, it seems to me somewhat unlikely that the name of the cocopalm should have been derived from that of the land crab (or other crab), that preys upon it. Man is much more interested in the many uses he derives from the tree than in the crab; and the tree has, I imagine, a very much wider area of distribution than the crab.
>
> As a matter of fact, however, the name of the tree does not, as a rule, resemble that of the crab. Its most diffused general name in the eastern islands from Madagascar to the Marquesas, is *niur*. Other names, such as *kelapa*, *kelambir*, and the Celebesian *kaluku* (of which *Koekoe*, *i.e. kuku*, may be either the primitive or the reduced form), are more local.
>
> So, I should suppose, are such crab names as *kuku* and *kukuma*. In Malay and other Indonesian languages, such as Javanese, etc., there are two words:
>
> (1) *Kuku*, claw, hoof, nail (of finger or toe).
> (2) *Kukur*, claw, to claw, to rasp, probably variants of one word. (There is also a variant with a final *-t*, *kokot*, in some places.)
>
> In practically all parts of Polynesia, from Fiji to New Zealand, and Hawaii to the Paumotus, are found derivatives of either (1) or (2) or both, in the sense of 'claw, nail, hoof', or 'to nip', and the like. As these languages tend to drop final consonants, it is difficult to say whether such words belong to (1) or (2). But apparently they do not generally mean 'crab'. It seems reasonable to connect these words with the local names of the crab. Compare Malay *ketam*, 'crab', but also 'to nip', found in several languages from Sumatra to the Philippines.
>
> I do not think the Arabic *khukhum* can be more than a fortuitous case of resemblance. I do not know it.
>
> As for the relation of all this to *coco*, I fail to see how it can be accepted in view of the fact that the word occurs in Vasco de Gama's Roteiro (1498) and in the book of Barbosa (1516), both written before Europeans got far enough east to reach the region where the cocopalm or nut is called *kuku*. The word seems to be quite European (Portuguese and Spanish).

The coconut is of great antiquity in Ceylon, and the earliest mention of it, Mr. Stockdale informs me, occurs in the "Mahawansa" in the reign of Dutthagamani, 101–77 B.C. Hsüan Tsang (II, p. 252), who travelled during A.D. 629–645, refers to coconuts in the Island of Na-lo-ki-lo (=Narakira—coconut=? Maldives), and says, "The people of this Island grow no grain but live only on coconuts". The Government Archivist of Ceylon also informs me that Sinhalese taxes on coconuts were in existence in pre-Portuguese times and were called *Pol watta-piediya* and *Polaya-panam* (*Pol*=coconut in Sinhalese, *watta*=garden). In Yule and Burnell's "Hobson-Jobson", the passages quoted referring to the 'Argell' or 'Great Indian Nut', from Cosmas, the Monk, *circa* A.D. 545 or A.D. 547,[10] and others lend further support to its Old World origin.

As opposed to the theory of the Polynesian origin of the coconut, Chiovenda (l.c. p. 398 and p. 449) holds the view that it originated in lands, now submerged, somewhere in the north-west of the Indian Ocean. He refers to Reinaud's records of the Indian, Albirunhi, in the eleventh century, who mentions the submergence of land in the region of the Laccadive and Maldive Islands, and of how the people of these islands, when fleeing for safety, took their coconuts with them. He also refers to fossil Cocoineæ, related to *Cocos*, having been discovered in Central Europe.

The fact that the early explorers found the Coconut palm of very limited distribution in tropical

[8] Smith, Geoffrey. "Cambridge Natural History", Crustacea, 4 (1909), pp. 173-175.
[9] "Eastern Pacific Lands." Appendix B, p. 234.
[10] See Yule, "Cathay and the Way Thither", i., p. clxxvi. (1866), and Cosmas, "Indico pleustes", book xi. "The Christian Topography of Cosmas", trans. and ed. by J. W. M'Grindle, p. 362 (1897).
In Yule's "Hobson-Jobson", the etymology of the word 'coco' is fully discussed; see also Bayley-Balfour, *Ann. Bot.*, vol. i., p. 184, and Garcia da Orta, l.c. p. 139.

(*Continued on p.* 151.)

Supplement to NATURE

No. 3117 JULY 27, 1929

Africa and Science.

By JAN H. HOFMEYR, President of the South African Association.

INAUGURAL ADDRESS DELIVERED AT CAPE TOWN ON JULY 22 TO THE BRITISH AND SOUTH AFRICAN ASSOCIATIONS.

TO-NIGHT I enter upon the consummation of what is at once the highest and the least merited distinction which it has been my privilege to receive. To those who called me to the office of president of the South African Association for the Advancement of Science I tender my sincere thanks. I make myself no illusions in respect of the adequacy of my claims to that honour on the ground either of scientific attainment or of services rendered to the cause of science, nor would I have our visitors remain for a moment without the knowledge that my scientific qualifications for this presidential chair are of the slightest. They are far less indeed than those of that distinguished statesman to whom, when he had remarked to the great Faraday in relation to an important new discovery in science, "But after all, what is the use of it?" the scientist replied, "Why, Sir, there is every probability that you will soon be able to tax it."

The presidency of this Association is an honour the conferment of which upon myself has never seemed to fall properly within the scope of my ambitions; it imposes responsibilities for the discharge of which I am all too scantily equipped; and I can only seek to justify my election in a manner similar to that which Mr. Stanley Baldwin followed when he was chosen to be president of the Classical Association in England. I can but say that, while it is to the scientist that we look for the advancement and the progress of science, the effectiveness with which his work is brought to fruition does depend in some measure on the interest, the sympathy, and the enthusiasm with which his achievements are followed up by that army of plain, ordinary men, in which I gladly count myself a musket bearer. In no other capacity dare I venture to address you. It was once said by a literary man of some distinction that the man of science appears to be the only man in the world who has something to say, and he is the only man who does not know how to say it. There is an obvious rejoinder, that the man of letters frequently has nothing to say, but says it at great length. I dare not claim to be a man of science. I can only hope that I shall not be deemed to have qualified for consideration as a man of letters in the sense of that retort.

The honour which has been conferred upon me is the greater because of the special significance which attaches to my year of office. It is the year of the keenly anticipated second visit of the British Association for the Advancement of Science to South Africa, and for that reason my first words are, happily, words of welcome. Not merely the Association for which I speak, but also all South Africa, rejoices in the presence of the British Association and its distinguished members. To its parent body, which can look back upon all but a century of glorious achievement, this stripling Association brings its tribute of respectful admiration and goodwill. To the great organisation of scientific men, the history of which is the history of the advancement of science in Britain, which has a presidential roll adorned by names such as Brewster and Tyndall, Huxley and Kelvin, Rayleigh and Lister, this land of ours, mindful of its debt to science, conscious of the gifts that science can yet bring to it, extends the hand of friendship, in gratitude for the honour of this visit, and in appreciation of the stimulus to its progress and development which must needs attend it.

We have reason, indeed, to be grateful to the British Association for its achievement and its significance. If I might select three distinctive features in its record, they would be these. First,

its contribution, direct and indirect, to those great triumphs of British science in the nineteenth century which are the possession not of an age, or of a nation, but of all time and of every land. Directly it has initiated, correlated, and contributed towards work of great scientific value; indirectly it has inspired much constructive activity, while its meetings year after year have done more than any other single factor to stimulate and hasten the onward march of science.

Next I would dwell on its maintenance of a broad view of the scope and function of science, and, coupled with that, the emphasis laid by it on the essential homogeneity of science conceived thus broadly, and the interdependence of its several branches. The Association had no lack of opposition to encounter at its coming birth. Those who interpreted science primarily in the medieval sense as being limited to the sciences of introspection had still but scant respect for the claims of the sciences of observation. When in the second year of its existence the Association visited Oxford, Keble protested vigorously against the University's reception of what he called a hodge-podge of philosophers. This hodge-podge, be it noted, included Brewster and Dalton and Faraday. But the Association did not react into narrowness. It remained true to the broad conception of *Scientia* which was held by its founders, one of whom affirmed in striking language at the first meeting, that "The chief interpreters of Nature have always been those who have grasped the widest fields of inquiry, who have listened with the most universal curiosity to all information, and felt an interest in every question which the one great system of Nature represents".

The Association has imposed no narrow restrictions on the extension of the sphere of its activity; within that ever-widening sphere it has maintained a spirit of co-operation between workers in diverse fields which has been worthy of the best traditions of Francis Bacon. It has had its reward—in greater effectiveness of work in its own sphere, and in the permeation of the kingdom of learning with the atmosphere of goodwill. By way of illustration of this last point, may I, as one whose first allegiance is to the classics, mention the fact that the roll of twenty-six presidents of the Classical Association of England includes five fellows of the Royal Society, names such as Geikie, Osler, and D'Arcy Thompson, and if it is not too presumptuously personal to refer to it, I would add, that when the South African Association elected me as its president, it chose one who was then president of the Classical Association of South Africa.

Lastly, I would select as characteristic of the British Association its success in maintaining the contacts of science with the public on one hand and the State on the other. One of the aims which its founders set forth was "to obtain more general attention for the objects of Science"; they sought to create a body which would make its appeal to the educated public as a whole, to fashion an instrument for the interpretation of the sometimes highly technical results of scientific investigation to the man in the street. They realised that the scientist received much from the public, that to the public he must freely give, and that the giving would not be without its due reward of new inspiration and renewed enthusiasms. There were some who opposed the nascent Association in the fear that science might degrade itself by making too popular an appeal. That fear has been belied in the passing of the years. The Association has kept touch with the public, it has "demonstrated to all men that science is thinking with them and for them", it has secured their interest and their sympathy, but it has never paid for that achievement the price of a lowering of its aims or of its standards. It is its success in this respect that has secured for it the prestige which has enabled it time and again to stand forth as the ambassador of science to the State, and so to play an important part in initiating and furthering enterprises of great national and scientific significance.

For these reasons and for much else, South Africa is proud and happy to be able to welcome and do honour to the British Association for the Advancement of Science. We welcome it the more heartily because of our consciousness of the greatness of our indebtedness to the first visit of the Association twenty-four years ago. To that visit, with which there will always be linked a name honoured in the history of South Africa, as it is in the annals of science—I refer to Sir David Gill—this country still looks back with grateful recollection. It marked the commencement of an epoch in our scientific history, the epoch of the consolidation of the position of science in South Africa.

Progress of Science in South Africa.

Let us view the position of science in our country as it was in 1905. On the academic side it is the nakedness of the land that chiefly impresses us. South Africa then had but one university, and it was in reality only a board of examiners for the

candidates presented by various colleges, which were all, without exception, inadequately staffed and poorly equipped. In the subjects which fell within the scope of the Association, as it was defined in 1905, there were in all the colleges taken together in that year only forty-nine workers, thirty-three professors and sixteen others. When it is remembered that this was the total number of teachers of all branches of science spread over seven different institutions, all purporting to do university work, it is painfully obvious how little time was available for scientific research and investigation. Nor was the work done, measured in terms of the number of graduates, very impressive. The number of those who in 1905 qualified for degrees in pure and applied science was only twenty-seven.

Outside of the colleges, scientific workers were to be found mainly in government departments, then still small and inadequately staffed, and working in isolation in the four South African colonies. In most branches the State's scientific activities were still in their earliest infancy. The organisation was only just commencing to be built up. As part of these activities there fall to be mentioned the two astronomical observatories at that time in operation: the Royal Observatory at Cape Town, then already full of years and of honour, and the Johannesburg Observatory, which, thanks largely to the representations made by this Association of ours, had been established a few months before the 1905 meeting.

In regard to scientific societies there is but little to record. There was in existence in 1905 a small South African Philosophical Society (now known as the Royal Society of South Africa), the Geological Society of South Africa, the Cape Society of Engineers, the Chemical Metallurgical and Mining Society, and also this Association for the Advancement of Science, which had come into existence a bare three years previously. It was, indeed, the day of small things, and small also was the achievement which science in South Africa at that date had to its credit. If one leaves out of account the work of Sir David Gill and the scientific endeavour which had been put into the development of the gold-mining industry of the Witwatersrand, there is little indeed of permanent significance that remains.

Against this picture it is appropriate to set the picture of South African science as it will unfold itself to our visitors to-day. They will find three vigorous single-college teaching universities, which have in recent years made remarkable progress in the attainment of the standards of similar institutions in older lands, and also a federal university with six constituent colleges, which, like the single-college universities, are, in human and material equipment and in the output of the results of scientific investigation, very far ahead of their predecessors of 1905. Against the forty-nine workers of 1905 we can now set 429—134 professors and 295 others—within the range at present covered by the activities of this Association. The twenty-seven graduates of 1905 increased to 275 in 1928.

To the scientific societies of 1905 there have been added, since the last visit of the British Association, the South African Institute of Electrical Engineers, the South African Institution of Engineers, the Cape Chemical Society, the South African Chemical Institute, the Botanical Society of South Africa, the South African Biological Society, the Astronomical Society of South Africa, the South African Geographical Society, and the South African Economic Society, and this Association of ours has become an active, vigorous, and powerful body, proud of the achievements which it already has to its credit, challenging eagerly the tasks that await it in the future. The two observatories of 1905, our visitors will find, have increased to six, including the Smithsonian Solar Observatory in South-West Africa, and the equipment of these institutions includes four great telescopes, with objectives of 27 inches, 26½ inches, 26 inches, and 24 inches respectively, to which will shortly be added a 24-inch refractor and a 60-inch reflecting telescope—surely a remarkable astronomical equipment for so young a country. The stimulus of the 1905 visit, in which so many prominent European astronomers participated, has indeed borne rich fruit in the advancement of astronomical work in South Africa.

Perhaps our visitors will be impressed not least by the development and consolidation of the scientific departments of our Civil Service, by the magnificent Institute of Veterinary Research which the State has created at Onderstepoort and the effective work which through its scientific officers it is doing for the development of South Africa, and by the remarkably efficient and well-equipped Institute for Medical Research at Johannesburg, the credit for the establishment and maintenance of which falls jointly to the Government and the mining industry. Significant also of the attitude of the State to science, and full of promise for the future, has been the establishment of a Research Grant Board, which advises the Government on the practical measures necessary for the encouragement

of scientific research in the Union, and acts as its agent in the distribution of grants in aid of individual investigations.

Nor have we reason to be ashamed of the positive achievements of science in South Africa during the past quarter of a century. Most impressive, perhaps, regarded cumulatively, have been the advances made in our knowledge of the diseases of plants, animals, and men, and of the methods of preventing them. In 1905 we knew practically nothing of the plant diseases of South Africa. In that year the first steps were taken towards their scientific investigation. To-day a general survey has been completed, most of the important diseases have been worked out, and a highly efficient service for combating them is in operation. In 1905 also the Transvaal Crown Colony Government voted £1500 as a first instalment towards the establishment of a laboratory for the investigation of stock diseases. From that has sprung the magnificent body of work in veterinary science which has won world-wide recognition for the Onderstepoort Institute which I have already mentioned. More recently there has been founded the South African Institute for Medical Research, to which is allied the Miners' Phthisis Medical Bureau. The researches conducted there in the control of pneumonic infection, and the advances made in industrial hygiene in the fight against silicosis, have brought great lustre to these two institutions and to South Africa.

In other fields also South African scientific workers have won recognition. In geology, marine biology, the mathematical theory of determinants, the economics of gold production, and along several other lines of investigation, important scientific work has been done in South Africa ; a succession of discoveries has been made throwing light on the origins of the human race ; and applied science has by means of the conquest of distance in this far-flung land of ours, and of the construction of important irrigation and other engineering works, contributed generously to South Africa's progress. It may, perhaps, be taken as a measure of the achievement of science in South Africa in one of its aspects that, while in 1906 the value of products of the land exported from South Africa amounted to £5,928,000, the corresponding figure for 1927 was £27,815,000.

If I were asked to select the most broadly significant feature in the development of science in South Africa since 1905, however, I think I would pick out what one might describe as its South Africanisation. In 1905 science in South Africa was in large measure exotic. The workers had come almost exclusively from other lands. They were only beginning to apply themselves to our South African problems. In many cases they had not yet acquired a South African background, or a South African outlook. In the years that have passed South Africa has claimed those workers for her own, and they have given themselves to her service. They to whom this is the land of their adoption, no less than those to whom it is the land of their birth, and whom they have taught and inspired, have made it the land of their vigorous and devoted service. In its personnel, science in South Africa has become essentially South African ; and science has given itself with enthusiasm to the problems of South Africa. It has emphasised the specific contributions of South Africa to the wider problems of science, it has applied itself to the removal of those obstacles which hamper the material development of South Africa, it has taken up vigorously the study of South African economics and sociology and anthropology. Perhaps also one may claim that it has brought to bear on scientific investigation what we regard as the distinctive features of the South African outlook—freshness and breadth of view, receptivity to new illuminations, and readiness to see old truths in new settings and in the light of their wider bearings. Is it not South Africa that has given to science and the world the conception of holism ? And there is surely no gift more worthily representative of the South African outlook at its best that we could have offered. It may indeed be that that very South Africanisation of our South African science of which I have been speaking is but another instance of the holistic principle at work.

As I speak of the South African outlook in science, I cannot but direct attention, with that deep appreciation which I know we all feel, to the masterly address which four years ago General Smuts delivered from this chair, when he demonstrated in so compelling a manner (I quote his own description of the task he set himself) " that there is something valuable and fruitful for science in the South African point of view, that our particular angle of vision supplies a real vantage point of attack on some of the great problems of science ; and that, so far from the South African view-point being parochial in science, it may prove helpful and fruitful in many ways to workers in the fields of scientific research and investigation ".

Science in South Africa, then, has made itself truly South African, and in doing so it has established itself in the admiration and affection of the

people of this land. As a nation we are grateful to our scientists for their contributions to our intellectual and material progress. The liberal policy of the State in supporting scientific effort we heartily endorse; the increase in the mental stature and the prestige of the nation which science brings to us we sincerely welcome. We are proud of our South African science, not least because we know that we can regard it as distinctively ours. But while our science has been South Africanised, we can rejoice that there is nothing narrow about its South Africanism. Were it otherwise, it would have been false to the spirit of science. In applying itself to the problems of South Africa, it has succeeded in attracting the attention of the scientific world to South Africa. In that address to which I have already referred, General Smuts emphasised the fact that recent events had drawn the eyes of the world to this land of ours as a rich field for scientific investigation. "The scope for scientific work", he said, "in this department of knowledge" (he was referring more especially to human palæontology, but his words are of wider applicability) "is therefore immense; the ground lies literally cumbered with the possibilities of great discoveries. . . . Science has in South Africa a splendid field of labour; other nations may well envy us the rich ores of this great 'scientific divide' which is our heritage." Those words are well worth remembering. We speak sometimes of our wealth in South Africa—mineral wealth, agricultural wealth, potential industrial wealth—but great also is our scientific wealth, and great is the debt we owe to South African science for what it has done to reveal that wealth to ourselves and to the world.

There, then, in brief outlines, all too imperfectly drawn, is a picture of South African science in 1929. Contrast it with the picture of 1905, and you have the measure of the achievement of a great epoch. Science consolidated, science South Africanised, science recognised as of great national value, both in the spiritual and in the material spheres, science drawing to our country the eyes of the world—surely that is no unworthy achievement. As once more, after the lapse of many days, our Association makes its report to the parent body, to which it gladly pays the tribute of filial reverence, it does so with pride and satisfaction in the work of the intervening period, but also with grateful recognition of the inspiration which that visit of 1905 brought to South Africa as one of the constitutive factors in the progress of the last quarter of a century.

Leadership in Africa.

Now it has been our privilege to welcome this second visit of the British Association. Is it strange if we ask ourselves, as we gratefully remember the stimulus of 1905, what will be the stimulus of 1929? That visit had abiding results. What will be the results of this one? That visit inaugurated a new epoch. Are we not justified in believing that once again we stand on the threshold of a great advance? If that be so, what are to be the characteristics of the period on which we are now entering? What will be its achievement? In the period that followed the first visit of the British Association, we South Africanised science in South Africa. Is it too much to hope that in the next we shall Africanise it? Will not this visit perhaps give us the impulse and the inspiration to a bigger and a bolder enterprise? One of the most significant tendencies evidenced in South Africa in the last few years has been the growing consciousness of our obligations in relation to the continent of Africa. We have come to realise that the position of this European civilisation of ours set upon the verge of this great continent is a position of unique strategic importance, that it presents us with at once an opportunity and a challenge. While in the past we thought, as a nation, almost exclusively of our own problems and difficulties, we are now ceasing to limit our horizon by the Limpopo, we are beginning to envisage the task that awaits us beyond our own borders. In the mind of the nation there is being developed a new conception of South Africa, of a South Africa that consciously and deliberately seeks to play its part on the African continent, not aiming at conquest or domination, but never failing in its readiness to give its intellectual and material resources to aid all who are engaged in the task of developing this great undeveloped area of the earth's surface, which is so full of potentialities for the future welfare of the world.

If, then, South Africa aspires to leadership in Africa in other branches of activity, why not also in science? If the outlook of the nation is broadening, why should not its scientists also begin to think in continents? If as a people we are anxious to make our contribution to Africa, eager to give it of our best, rather than to get from it that which will be to our material advantage, why should not our science also become consciously and deliberately African in its outlook, its ideals, and the tasks to which it applies itself? If science has consolidated its position in South Africa, as

we believe it has, is it not fitting that, with South Africa as its base, it should enter now into the new sphere of opportunity and achievement which stretches mightily outwards from its borders ?

To our visitors I look to give us the stimulus and the encouragement to that enterprise. You have come to Africa. This great land-mass which has reared itself against time's passage, almost since time's beginning, and holds inviolate so many of the records of that passage, has challenged your attention. You have come to Africa to seek new inspiration for the study of the problems that interest you, by seeing them against a different background which has for many of you an unaccustomed vastness. But while Africa was your goal, you did not think fit to enter it at the point nearest to your homes. You steamed down, day after day, skirting the long coast-line of this vast expanse of veld and forest, and have entered it by its southern gateway. For a great body of scientists it is the only point of effective entry into Africa. It is by way of this southern gateway that science itself can most effectively be made to permeate Africa. To you, having so come, to you, the ambassadors of science, I present—Africa. It is Africa and science, which, I would like to think, are to-day met together. Happy indeed should be the fruits of the mating.

Africa as a Field of Scientific Endeavour.

It is to that theme—Africa and science—that I propose now to invite your attention. What can Africa give to science ? What can science give to Africa ? Those are the questions to which I would address myself. But as I speak, I would ask you all to remember that it is for the South African scientist that the answers to these questions have primary significance. It is for him that they have significance, because for the solution of many of the problems of South Africa a greater knowledge of Africa as a whole than is at present available is essential, and the extension of that knowledge is his personal responsibility. It is for him that they have significance, because he dwells in a land which is strategically placed for attacking the problems of Africa and for drawing forth its hidden resources of scientific discovery for the enrichment of science throughout the world.

What, then, can Africa give to science ? In reply to that I can do no more than suggest some of the lines along which Africa seems to be called upon to make a distinctive contribution to science.

First there are the related fields of astronomy and meteorology. To astronomy I shall but make a passing reference. This continent of Africa, more especially the highlands of its interior plateau, with its clear skies and its cloudless nights, offers wonderful facilities to the astronomer. As proof of the necessity of utilising those facilities, especially with a view to the study of the southern heavens, I need but quote the words used by Prof. Kapteyn on the occasion of the 1905 visit : "In all researches bearing on the construction of the universe of stars, the investigator is hindered by our ignorance of the southern heavens. Work is accumulating in the north, which is to a great extent useless, until similar work is done in the south." Africa has to its credit considerable achievements in the past in the field of astronomical research. The increased equipment now available should make it possible to increase greatly the amount of systematic work now being done, and to offer important contributions to astronomical science.

Probably of greater importance is the work waiting to be done in meteorology. Few branches of science have a more direct effect upon the welfare of mankind—that is a lesson which we in South Africa should have learnt only too well—but in few has less progress been made. In meteorological work Africa is probably the most backward of the continents. It is not so long since Dr. Simpson of the London Meteorological Office declared that, save from Egypt, his office received practically no meteorological information from the great continent of Africa. Moreover, the backwardness of meteorology is in large measure due to the intricacy of the problems involved, and the necessity of having world-wide information made available. The problems of meteorology are emphatically not the problems of one country or of one region. The South African meteorologist must see his problems *sub specie Africae* (the seasonal changes in South Africa depend on the northward and southward oscillations of the great atmospheric system overlying the continent as a whole) ; and quite apart from what he can learn from the rest of Africa, the Antarctic regions have much to teach him. But while the development of meteorological research throughout Africa is of supreme economic importance for Africa, Africa in its turn has its contributions to make to other continents. In particular should we not forget the close inter-relation of the meteorological problems of the lands of the southern hemisphere. The central position of Africa in relation to those lands gives not only special opportunities but also special responsibilities for meteorological observation and research. For the sake both

of South Africa and of science in general, I would venture to express the hope that this second visit of the British Association will give as powerful a stimulus to meteorology as did the first to astronomy.

Next, I would refer to Africa's potential contributions to geological science. Africa is a continent, portions of which have always had a special interest for the geologist because of the great diversity of the geological phenomena manifested, and the vast mineral wealth which, as its ancient workings so abundantly prove, has attracted man's industry from the very earliest times. But in our day the opportunities which it offers to the geologist to make contributions to the wider problems of science are coming to be more fully realised than ever before. Of special interest in this connexion is the light which African geology, more especially in the form of the study of ancient glacial deposits, can throw on the Wegener hypothesis of continental drift. In the past our geologists have thought mainly of the correlation of our formations with those of Europe. It is time that they paid more attention to their possible affiliations with those of the continents to east and west of us. If geology can establish the hypothesis that Africa is the mother continent from which India, Madagascar, and Australia on one side and South America on the other have been dislodged, it will give a new orientation to many branches of scientific activity. For that investigation also Africa occupies a central and determinative position in relation to the other continents, such as we have noted to be the case in the sphere of meteorology.

There are many other geological problems on which Africa can probably shed much light. There is, for example, the constitution of the earth's deeper sub-strata, in regard to which, as Dr. Wagner has recently pointed out, the study of the volcanic Kimberlite pipes, so numerous throughout Africa south of the equator, and of the xenoliths they contain, including the determination of their radium and thorium contents, may be of the greatest significance. There is the possibility that the exploitation of Africa's great wealth in potentially fossil-bearing rocks of presumably pre-Cambrian age will yet yield us remains of living beings more primitive than any yet discovered ; there are the great opportunities of study which the African deserts offer in the field of desert geology and morphology, and there is the assistance which African geology has rendered to vertebrate and plant palæontology, and can render to African anthropology in the investigation of this great museum of human remains and relics which we call the continent of Africa.

I pass on to medical science. I have referred already to the contributions to the study of the problems of industrial medicine and hygiene which the special circumstances of the South African gold-mining industry have made possible. Those contributions have, we may well hope, but prepared the way for advances of a revolutionary character in the early detection, prevention, and treatment of all forms of respiratory disease. But even greater are the opportunities which the continent of Africa offers for the study of tropical diseases, of which it may well be described as the homeland. In Africa there have been, and necessarily must be, studied the problems connected with malaria, blackwater fever, sleeping sickness, yellow fever, and many other scourges of civilisation, and from Africa there may well come hope and healing for mankind.

There are other problems of medical science for the study of which Africa is uniquely fitted. There are the physiological questions, important also from the political point of view, which bear on the fitness of the white races to maintain a healthy existence in tropical surroundings, at high altitudes, and in excessive sunlight. For these investigations the diversity of conditions prevailing in the various regions of the African continent make it a magnificent natural laboratory. There is the elucidation of the factors which account for the varying susceptibility of white and coloured races to acute infectious diseases, tuberculosis, and certain types of malignant disease, together with the light which such elucidation may throw on the physical and chemical composition of the human body.

Lastly, I would mention the exploration of that most interesting borderland between psychiatry and psychological science by an analysis of the mentality of the diverse African peoples. That investigation has an important bearing not only on the limitations and capacities of racial intelligence, but also on the methods which the ruling races in Africa should follow in seeking to discharge their obligations towards their uncivilised and unenlightened fellow-Africans.

Closely linked with medical science is the study of animal biology. In some instances the problems of the two branches of science are to be approached along parallel lines ; in others biological investigations are fundamental to the growth of medical science ; of no less significance is that unity which there is in Nature, making it possible for the truths of animal biology to be translated into

facts concerning mankind. In the African continent there is no lack of opportunity to advance science by physiological inquiries into animal structure, by the isolation of the parasites of human and animal diseases, and by the tracing of the life-histories more especially of the minuter forms of animal life. "Nowadays," in the words of Prof. J. A. Thomson, "the serpent that bites man's heel is in nine cases out of ten microscopic." But scarcely less important are the extensive facilities which Africa still offers for the study of the habits and behaviour of the larger mammals. The naturalistic study of these animals, not as stuffed museum species, but in the laboratories of their native environment, has received all too scanty attention from the scientist, and this is a reproach which African science, with its rich dowry of mammal and primate material, may confidently be expected to remove. Nor will this study of animal behaviour, especially of those animals which approach nearest to the human type, be without its bearings on our investigations of the workings of the human mind.

If in this hasty survey I may take time to mention one more point within this field, I would refer to the results which await the intensified activity of the marine biologist and the oceanographer in the as yet all but virgin territory of the African coast-line. This Association of ours has long dreamed of an African marine biological station as broad in its conception and comparably as useful from the wider scientific and the more narrowly economic points of view as those of Plymouth or Naples or Woods Hole, and withal a rallying point for the naturalist, the zoologist, the botanist, the geographer, the anatomist, the physiologist, indeed for all those workers whose diverse problems meet at the margin of the sea.

Origin of Man.

From animal biology we pass by an easy transition to anthropology, the study of man himself. Here Africa seems full of splendid promise of discovery that may verify Darwin's belief in the probability that somewhere in this land-mass was the scene of Nature's greatest creative effort. It would seem to be not without significance that Africa possesses in the chimpanzee and the gorilla those primate types which approach most nearly the form and structure of primitive man. To that must be added that in the Bushman, Pigmy, and negroid races Africa has at least two and possibly three early human stocks which are characteristically her own and belong to no other continent. No less striking is the fact that in Gibraltar, in Malta, and in Palestine, that is, at each and every one of the three portals into Africa from Europe and Asia in Pleistocene times, there have been discovered evidences of the presence of Neanderthal man. In Africa itself there was found at Broken Hill some nine years ago a skull with the most primitive or bestial facial form yet seen, and so closely akin to the Neanderthal stock as to establish firmly the expectation of finding further compelling evidence of a long-continued Neanderthaloid occupation of the African continent. The discovery at Taungs on one hand, which reaches out towards the unknown past, and the finds at Boskop and in the Tsitsikama on the other, which assist in linking up the period of Rhodesian man with the coming of the Bushfolk, open up to us, in conjunction with the aforementioned facts, a vista of anthropological continuity in Africa such as no other continent can offer. The recent investigations in the Great Rift Valley, near Elmenteita in Kenya, and the fossil discoveries on the Springbok Flats, north of Pretoria, have again fixed the attention of the anthropologist on Africa.

Nor are the data presently available restricted to these discoveries. The efforts of archæologists, and the application of improved scientific methods in excavation, are giving us stratigraphical evidence of the succession of stone cultures which is of the utmost importance. I have already mentioned the assistance which geology can render in this work, but there is needed also the co-operation of those who labour in the converging fields of anatomy, archæology, palæontology, and comparative zoology. That co-operation has already commenced. In the investigation of the Vaal River gravels it has yielded important results, and we may look forward to its continuance and expansion in the years that lie ahead. Of the importance of African anthropology for the understanding of that of Europe there can be no question. Work of importance has already been done in the study of the relations between palæolithic art in Europe and palæolithic art in Africa. The significance of these comparisons is but emblematic of the importance of similar investigations in regard to stone cultures, rock engravings, ancient mining, stone circles and ancient ruins, methods of primitive mining and agriculture, tribal organisation, laws and customs, indeed the whole range of the hitherto unexplained or partially explained phenomena of living and extinct cultures. There is no lack of avenues which the student of African anthropology may follow in the hope of finding at the end of them results of supreme value for science in general.

I would speak next of the vast field, as yet lmost uncharted, of phonological and philological udy. Here in Africa we have great opportunities r the examination of linguistic problems, and me of them have bearings which extend far beond the limits of Africa. One thinks first of the pportunities which Africa offers for investigating ie results of the transplantation of languages hich have a long history of cultural development ehind them to regions inhabited by primitive eoples. Here there are two sets of phenomena, ch with its own special interest. On one hand e have the modification of the languages of those uropean peoples who have established themselves Africa as permanent settled communities, under ressure of the new linguistic influences with which ey have been brought into contact. Of these henomena the study of Afrikaans offers perhaps ie best examples to be found in the whole field linguistics—its importance for the student of mparative philology is very far from being adeuately appreciated. On the other hand, we have ose cases where European languages have come Africa as the languages not of settled comunities, but of officials and others like them who e but temporarily domiciled in this continent, d leave no descendants behind them to carry on ie process of evolution of distinctive forms of eech. Here the phenomena which are of inrest to the student of linguistics are to be found the wealth of deformation and adaptation hich the native populations have introduced in eir endeavours to speak the European languages their rulers. Work such as has been done by chuchardt in Negro-Portuguese and Negro-French pens up a wide area of most attractive investiation.

The most important task in the field of African nguistics, however, is the actual recording of the ative languages in Africa, our backwardness in spect of which is a reproach to science. Such udy is, of course, important in relation to Africa self, but of even greater significance for my resent purpose is its bearing on scientific problems wider scope. In that connexion I would suggest vo points. We are still only at the beginning of ie study of comparative Bantu. That in due ourse should lead to a knowledge of Ur-Bantu. uch a study and such a knowledge will necessarily e of importance to the comparative philologist, oth because of the light shed by the study of one roup of languages on the study of other groups, nd also because it opens the way to the investigaon of the relationship of Bantu to the other African tongues, and its place in the general scheme of the languages of the world.

Of even greater interest is the study of African languages as throwing light on the interpenetrations and interactions of primitive peoples. Language is a function of social relationship, and its study is therefore of great value for ethnological and historical investigations. May I give one instance of what I have in mind? Two millennia back, south-west Arabia was the seat of the powerful commercial civilisations of the Mineans, the Sabæans, and the Himyarites, radiating eastwards to India and south-westwards to Africa. The extent of their relationship with Africa it has hitherto been most difficult to trace, but linguistic evidence may prove to be of great value. Prof. Maingard has pointed out to me that the Makaranga who live near Zimbabwe call water *Bahri*, a word closely related in form to *Bahr*, the 'sea' of the Arabs, although the Makaranga themselves are not a seaboard people, and that *Shava* is their word for 'to sell or barter', while to the Himyarites *Saba* meant 'to travel for a commerical purpose'. Not less suggestive is the study of place-names, and while I do not suggest that I have evidence on which any conclusion can be based, I do contend that these investigations may prove to be of a most fruitful character. It would be interesting indeed to see what evidence linguistics can bring in respect of the relationship of South Africa with Madagascar, and also with Polynesia through Madagascar, where the tribe once dominant politically, the copper-coloured Hova, are ethnologically and linguistically Melanesians amid the darker-hued Sakalavas and other negroid tribes. It may even be that such studies will conjure up to our minds pictures of great migratory movements with Arab dhows and South Sea proas cleaving the waters of the Indian Ocean. Only last year a canoe constructed of wood native to south-eastern Asia was found in Algoa Bay.

Finally, in this survey of what Africa can give to science I would refer, with the utmost brevity perforce, to Africa as a field, favoured as is no other, for the study of all those complicated problems which arise from the contact of races of different colours and at diverse stages of civilisation. Of those problems, ranging from the investigations of the biological factors involved in the conception of race to the practical problems of the administration of backward peoples, I need not speak. They have come to be part almost of the everyday thinking of most civilised men. What I would emphasise is that in Africa, as nowhere

else, the factors which constitute these problems can be studied both in isolation and in varying degrees of complexity of inter-relationship, that in Africa we have a great laboratory in which to-day there are going on before our eyes experiments which put to the test diverse social and political theories as to the relations between white and coloured races, that in Africa there are racial problems which demand solution, and the solution of which will affect or determine the handling of similar problems throughout the world. We hear men speak of the clash of colour, and are sometimes told that Africa is the strategic point in that struggle. I think of it rather as the continent which offers the richest opportunities to those who would investigate racial problems in the true spirit of science, and so discover the solutions, which may yet enable that clash to be averted and the threat which it implies to our civilisation to be dispelled.

Science and the Future of Africa.

I have sought—briefly and all too inadequately—to indicate some of the lines along which Africa seems to be able to make a distinctive contribution to science. It remains for me, yet more briefly, to speak of Africa's challenge to science, and to seek to answer the question, What can science give to Africa? I shall not stop to emphasise the point, that the greatness of Africa's potential contributions to science, the key which perhaps she holds to the riddle of human origins, the intriguing vistas opened up in the study of her relationship with South America and Australasia with its suggestion of past continental continuity, that all these and more constitute a challenge to science to actualise those potentialities. Let me seek rather to define the twofold challenge of Africa in another way. First, Africa defies science to unravel her past. Throughout history she has ever been the continent of mystery. She was so to that pioneer of geographers, Herodotus, to whom nothing that was told him about Africa was so improbable that he declined to give it credence. She was so to the Romans, who regarded Africa as the natural home and source of what was strange and novel and unaccustomed. She was so to the navigators who did so much to break down the barrier wall between the Middle Ages and the modern world; and though in our day the geographical mysteries of Africa have in large measure been solved, the work of the prober of her scientific secrets is only beginning.

Then, secondly, Africa challenges science to define, to determine, and to guide her future. If the great resources of this vast undeveloped continent are to be made available for humanity in our own and the succeeding generations, science must make it possible for the man of European race to undertake the work of development, by showing him how to protect himself, his stock, and his crops against disease, by enabling him to conserve and utilise to the greatest extent the soils, the vegetation, and the water supplies of the continent, by bringing to bear the resources of modern engineering on the exploitation of its wealth, and not least by determining the lines along which white and coloured races can best live together in harmony and to their common advantage.

That is the challenge of Africa to civilisation and to science. It is not now thrown out for the first time; it is not the first time that it will have been taken up. It is in Africa that the Greco-Roman civilisation won some of its most glorious triumphs, in Africa that the spade of the archæologist has in our day, by uncovering great Roman towns with noble public buildings and efficient irrigation systems, provided impressive evidence of the magnitude of the achievement of Roman Imperialism. But Rome failed to conquer Africa for civilisation, and left the challenge to those who were to follow after. She failed chiefly for two reasons: the might of African barbarism and the defiant resistance of African Nature. We in our day, confronted by the same challenge, still have the same enemies, hitherto victorious, to contend against. But we meet them with the advantage of having resources at our disposal which our Roman predecessors lacked. It is to use those resources effectively that Africa challenges science.

In dealing with African barbarism we have weapons such as Rome could never dream of, and not the least valuable are those provided by the scientific investigation of the native peoples of Africa. The way to the solution of the problems presented by African barbarism is to be sought in an understanding of the character and mentality of primitive peoples, in the exploration of those regions in their social life where are to be found the factors that determine their reaction to diverse methods of administration. The study of African languages and of African anthropology is therefore fundamental to the development of the continent. For that work Africa possesses special advantages, and one can but hope that the facilities now being built up in our South African universities will be recognised in Britain and elsewhere, and become an important factor in the response of science to the challenge of Africa.

Not less formidable is the conquest of African

Nature, for the achievement of which also we in our day are far better placed than were the Romans. It is modern science which gives us that advantage. Three great tasks confront science in the conquest of African Nature. First, science must make Africa safe for the white man to live in. I have spoken of the opportunities which Africa offers for the study of tropical diseases as likely to yield results of significance for science in general. But primarily, will those results be of significance for the development of Africa? This part of the challenge of Africa is not lightly to be taken up. Africa has taken heavy toll of science. The recent deaths in Nigeria of Stokes, Young, and Noguchi, worthy followers in the tradition of Lazear and Myers, are a reaffirmation of the gravity and insistence of that challenge. The importance for the cause of civilisation of a successful response to that challenge cannot be better illustrated than by the story of the construction of the Panama Canal. De Lesseps attempted the task and failed. For every cubic yard of earth excavated by him a human life was sacrificed to yellow fever or malaria. It was the successful attack some twenty years later, under the direction of General Gorgas, on the death-dealing mosquito, that made possible the completion of one of the most important engineering enterprises of modern times.

Secondly, science must combat the foes which have to be contended with in the development of African agriculture. Africa is prodigal indeed in the production of insect and other foes to cattle and to crops. Science is already making an effective response to this part of the challenge. But there is much that remains to be done, and we shall be none the worse for the timely realisation by the politician and the administrator of the contributions which science can make. All too often in the past, settlement schemes have been undertaken and ended in disaster in areas unhealthy to man, beast, or crops, when, if the scientist had first been called in, precautions might have been taken which would have averted the calamity.

Finally, science must harness the great resources of Africa. Here there are suggested to us all the varied contributions which the engineer can make in the work of development. Has not the Institution of Civil Engineers defined the ideal underlying all engineering activity as "the art of directing the great sources of power in Nature for the use and convenience of man"? Africa offers abundance of opportunities for the realisation of that ideal. It is not by working in isolation that the engineer will realise it, but rather by co-operation with his colleagues in other branches of science, and by the correlation and co-ordination of the essential data which they must do so much to provide. First in the order of engineering development come the civil and mining engineers. Their tasks are the provision of facilities for communication, for health, for the conservation of agricultural assets, for the production of raw material, and for the development of mineral resources. In their train there follow, with the advent of industrial activity, the mechanical and electrical engineers. Their tasks are to make the fullest use of the revolution in ideas of transport, including transport by air, which have resulted from the perfecting of the internal combusion engine, and to secure the maximum advantage possible from cheap production and efficient distribution of electrical power. The day must come, to give a concrete instance, when the Victoria Falls, with their immense water resources, will mean much more for Africa than Niagara to-day means for America. Later still there will be called in the services of the chemical engineer, ever engaged in problems of research to ascertain the most advantageous processes of converting raw materials into manufactured articles. In all these tasks it is the South African engineer who has, under the conditions of an undeveloped land, built up a technique and practice suitable to African requirements and showing promise of wider applicability, that we may well expect to assume a position of leadership and of inspiration. These are some of the ways in which science can respond to the challenge of Africa.

The picture which I set out to portray I have now completed. I have tried to suggest something of the magnitude of the rewards which Africa has in store for the scientist who has the enterprise to adventure and the vision to see. I have sought also to be the medium of the challenge presented to science by Africa's opportunities and needs. It is a vast canvas on which I have had to work. On it I have drawn but a few sketchy outlines. Yet I hope that the vision stands out clear. I hope that I have said enough to convey the power of its inspiration. Not least do I hope that our visitors will play a great part, in the time that they will spend with us, in filling in some of the details of the picture, and in quickening and vitalising its message for the scientists of South Africa. It is to them chiefly that it makes its appeal. The development of science in Africa, of Africa by science—that is the promised land that beckons them. I believe that they will not be disobedient to the vision.

Summaries of Addresses of Presidents of Sections.[1]

Cosmical Physics.

Lord Rayleigh's presidential address to Section A (Mathematical and Physical Sciences) is entitled "Some Problems of Cosmical Physics, Solved and Unsolved". He begins by reviewing the more outstanding cases of celestial spectra which still resisted identification after the discovery of helium. He traces how the strong lines of the nebular spectrum, formerly attributed to 'nebulium', were identified by Bowen as due to doubly ionised oxygen. He then goes on to the auroral spectrum, and after describing McLennan's investigations, which have led to the identification of the prominent green line as belonging to the arc spectrum of oxygen, he discusses the problems involved in the red line of the aurora, which up to the present has not been definitely traced to its origin. A nitrogen origin appears the most probable.

The spectrum of the solar corona is also regarded as an unsolved problem. Lord Rayleigh rejects the solution proposed by Freeman, who attributes the lines to argon. It is of interest that Russell and Bowen, in a paper which has appeared in the *Astrophysical Journal* since the address was prepared, have taken the same view.

Lord Rayleigh then discusses the conditions of excitation of some of these spectra. The theory of solar corpuscular streams is briefly reviewed, and some of the difficulties which have made it necessary to modify the original form of the theory as proposed by Birkeland. Reference is made to recent observation on echoes of short wave wireless signals, which are heard after an interval of several seconds. These echoes appear chiefly during times of magnetic disturbance, and Störmer has attributed them to reflection from the corpuscular streams of solar origin which exist in the earth's neighbourhood at such times. A very recent discussion by P. O. Pedersen adopts the same view.

The nebular spectrum, it is considered, is probably excited by ultra-violet light of short wavelength. Stress is laid on the peculiar richness in ultra-violet light of the central stars of planetary nebulæ, as emphasised by W. H. Wright before the origin of the nebular spectrum was realised. The mysteries still involved in absorption by the dark nebulæ, and in the excitation of cometary spectra, are also considered.

The address then passes to the discussion of the metastable states of excitation of atoms involved in the various spectra which have been discussed. Many of the lines of the nebulæ and the green line of the aurora are of the kind forbidden by the selection rules of the quantum theory in its present imperfect form. Laboratory experiments on mercury vapour, which is more amenable than oxygen or nitrogen to this purpose, have shown the possibility of observing such lines either in emission or absorption, in regions undisturbed by extraneous electric or magnetic fields.

After discussion of a few points in connexion with the layer of atmospheric ozone overhead, the remainder of the address is devoted to considering the cosmical possibility of unknown elements of higher atomic number than uranium, the highest known terrestrially. The list of elements is practically complete up to uranium, at which point it abruptly stops. It would seem, therefore, that any process of gravitational separation which has left heavier elements in the sun's interior, while eliminating them from the earth, must have succeeded in making an extraordinary clean and sharp cut. On the other hand, it appears that uranium must be coming into existence on the sun, as its duration is small compared with the probable age of that body. The analogy of radium would lead one to assume that uranium has a parent body of higher atomic weight. But such a parent body, if it exists, is *ex hypothesi* analogous to known radioactive bodies; thus even if we postulate it, we do not get any direct support for the view that matter may exist which is capable of dissolving entirely into radiation.

The Relation of Organic Chemistry to Biology.

In his presidential address to Section B (Chemistry) Prof. G. Barger traces various trends in the development of organic chemistry, particularly in relation to biochemistry and physiology. After directing attention to the isolation by Scheele of various organic acids and his synthesis of potassium cyanide, the address contrasts the early preparative investigation of natural products by some of the older chemists, such as Fourcroy and Vauquelin, with the work of others who were primarily inter-

[1] The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science, 1929". The volume is obtainable at 6*s*. of all booksellers or from the British Association, Burlington House, London, W.1.

ested in theoretical questions of radicles, substitution and types. This latter work led ultimately to the theory of structure, which soon became ground common to all.

A knowledge of structure gave a great impetus to synthesis, on which important industries were based. The number of known carbon compounds increased very rapidly and is now little short of a quarter of a million, but only a small proportion of these occur in Nature and a very small proportion are of general biological interest. The first systematic investigation of a whole group of biologically important substances was that of the fats by Chevreul; similarly comprehensive investigations of metabolic products were made later in Germany by Baeyer, Fischer, Willstätter, Wieland, and Windaus, when they applied organic chemistry to the study of the purines, sugars, proteins, plant pigments, bile acids, and sterols. A statistical analysis of papers on organic chemistry published during the last year in the *Berichte* and the *Journal of the Chemical Society* leads to the conclusion that British organic chemists are more interested in theoretical questions than their German colleagues and give much less attention to natural products.

The new borderline subject of biochemistry, based largely on the work of van 't Hoff and of Emil Fischer, may be said to have been definitely marked out early in the present century; thus in 1906 journals devoted to biochemistry were founded in three separate countries. The biochemist is not only concerned with the properties *in vitro* and the isolation of biologically important substances; he also studies the transformations which these substances undergo *in vivo*, when acted on by enzymes. These two sides of the subject have been called the descriptive and the dynamical. Both utilise to the full the resources of organic chemistry, its theoretical conclusions as well as its technique. In addition, the biochemist gives much attention to the working out of special methods of preparation and of analysis, required for the study of the complex problems with which he is concerned. These various aspects and relations of biochemistry are illustrated in the address by reference to recent investigations.

The taxonomic value of organic chemistry is very slight, except in the classification of bacteria, fungi, and lichens. Among Phanerogams the chief example of its utilisation is probably the genus *Eucalyptus*. The organic chemist may turn natural relationship to account in his study of alkaloids, but the systematic botanist is not influenced by their presence or absence.

Prof. Barger ends by pleading for a sympathetic teaching of organic chemistry, adapted to the needs of biological and medical students, and in this connexion quotes with approval from the presidential address to Section I by Prof. Lovatt Evans at Glasgow in 1928.

National Surveys.

The subject of Brigadier E. M. Jack's address to Section E (Geography) is national surveys. The duties and functions for which, in the opinion of the president, a national survey should be responsible, are discussed; then the work of the various national surveys, both foreign and in the Empire; and conclusions are drawn, with particular application to South Africa.

The main object of a survey is held to be the production of a map. The various operations necessary for this object are enumerated, and it is argued that a properly organised survey should be responsible for all these operations, from the initial triangulation to the printing, publication, and sale of the map, and its subsequent revision.

The question of maps is considered under the two main headings of cadastral and topographical. The characteristics of these two kinds of maps are described, and the opinion expressed that a national survey to be complete should be responsible for the production of both kinds.

Proceeding to a consideration of the surveys of the world, it is shown that the surveys of Europe have similar characteristics. They are mostly military in character, and their responsibility is confined to the production of topographical maps. Cadastral maps are produced by an independent department (usually financial) and are rarely published. Egypt forms a striking contrast, its survey (due to British organisation) conforming closely to the standard laid down.

In the United States various independent departments are responsible for different branches of survey. There has in the past been much independent action and doubtless some friction; but co-ordination has now been secured by the establishment of a Federal Board of Surveys. Very much the same description applies to the surveys of Canada.

The Survey of India produces only topographical maps. In Australia and New Zealand, on the other hand, topographical mapping is much neglected. Information is given as to various surveys in the African Colonies and Protectorates. A short description is then given of the Ordnance Survey of Great Britain.

The question of countries which have a divided

control of their surveys or have neglected some part is considered, and it is shown that such countries have suffered in consequence.

The position in South Africa is then considered. The recent Survey Act of 1927 has put survey in the Union in a much sounder position than it has ever been before. While responsibility remains divided between the Surveyors-General of the four Provinces and the Director of the Trigonometrical Survey, a 'Survey Board' has been established, consisting of these five officials. While this does not go so far as the Survey Commission of 1921 recommended, it is a great step forward in securing unity of control and uniformity of practice.

After touching on the difficult question of cadastral mapping in the Union, the question of a good topographical map of the country is discussed. Examples are given, taken from South Africa itself and from other countries, of the great need for such a map, and of the waste of time and money which results from the lack of it.

In conclusion, it is pointed out that South Africa has a great survey tradition, some of the finest survey work in the world having been done in the country. South Africans are urged not to lag behind, but to set an example to others; and to be determined to have a national survey adequate to their place among the nations, and worthy of their history and great traditions.

Physiology in the Treatment of Disease.

Prof. W. E. Dixon's presidential address to Section I (Physiology) reviews briefly the history of treatment in disease from the middle of the last century, when S. Skoda and K. Rokitansky (in Austria) perfected a system of physical diagnosis which has had a practical bearing on medicine ever since. Skoda made many experiments with drugs on the patient without any expectation of producing benefit; the patients were not improved, and Skoda thought it mattered little how the patient was treated. These views held the field even to the beginning of the present century, especially in Great Britain.

The experiments of Joig and his pupils in 1825 with camphor, digitalis, and other drugs on healthy men added nothing of value to our knowledge. Subjective sensations are produced, which are erroneously attributed to the drug which has been taken. Some experiments made with the late Dr. Rivers to illustrate these imaginary sensations were described. Such experiments on men as were made by S. Hahnemann and his pupils, by Perkin with his retractors, and by more modern physicians with their mystic apparatus, are valueless without proper controls. The influence of science on treatment is illustrated by reference to chemo-therapy and the internal secretions.

At one time hopes ran high that the chemical structure of the molecule might indicate pharmacological action. During the last fifty years, many laborious researches have been conducted with this object; to modify the molecule that it may conform to some required action. But the mystery remains as mighty as ever. It is most probable that subtle energy factors binding the molecule—factors not displayed in a formula—control the action; certain it is that drug action is not determined directly by chemical combination with body constituents, but rather by delicate physical processes such as those of absorption, solution, and surface tension. Illustrations are provided by action of the organic compounds, of the metals, dye-stuffs, and certain alkaloids.

In the last twenty years, much evidence has accumulated to show that the glands of internal secretion are responsible for the regulation of growth, of metabolism, and often for our appearance if not for our very character. Exaggeration or diminution in the secretion of one or other of the tissues may induce conditions so decided as to be obvious to everybody, though the effects produced by minor alterations in the co-ordination of the several secretions may not be so evident. Giants and dwarfs, unusual pigmentation and anæmia, disproportion in the growth of the skeleton, such as enlarged hands and face, bulging deer-like eyes or oriental eyes and beards in women, are noticeable to everyone; excessive fatness or emaciation, a choleric or bucolic temperament, cause no comment, yet may equally arise in the victim from a want of co-ordination in the internal secretion.

The general outlook and significance of drug therapy was led into new channels when it was revealed that the animal body through these glands elaborates its own drugs, stores them generally at the seat of formation, and doles them out to the tissues to meet the needs of the economy. Some of these drugs are of the nature of alkaloids comparable with those elaborated by plants. It is a remarkable fact that when Nature elaborates a drug in either a plant or an animal, that drug is invariably the ideal drug for producing the action for which it is characteristic. No drug relieves pain like morphine or produces local anæsthesia so well as cocaine; no drug paralyses the parasympathetics so perfectly as atropine or the motor nerves so effectively as curarine; strychnine super-

sedes all other drugs in exaggerating spinal reflexes, and caffeine in its remarkable power of stimulating the psychical centres of the brain. Of the animal drugs, adrenaline has a superlative effect on the sympathetic system, pituitary on the uterus, and thyroxin on general metabolism.

The elaboration of the drugs in Nature is on biological lines and the key always fits the lock: it seems as if Nature always says the last word on the particular type of drug she elaborates. Certainly organic chemists have up to now done little to improve on her products.

In conclusion, Prof. Dixon remarks that science is now engaged in endeavouring to remedy the evil effects which she has produced, to which he attributes tuberculosis, rickets, and especially the neurotic tendency in the highly civilised nations.

Experimental Method in Psychology.

The topic dealt with by Mr. F. C. Bartlett in his presidential address to Section J (Psychology) is the value and difficulties of experimental method in psychology. The earliest experimentalists in psychology were physicists and physiologists, most of them with a pronounced philosophical bias. They developed methods and set up standards which in various ways have hindered the growth of psychology as a true biological science. The physicist, approaching any problem of human reaction, tends to lay the chief burden of explanation upon the stimulus, by the simplification, control, and variation of which he explains observable differences in response. The stimulus is treated as outside the response itself. The difficulties to which this may lead are illustrated by special reference to the psycho-physical methods developed by Fechner, G. E. Müller, and others, and particularly by a consideration of how 'doubtful' judgments have been dealt with in psycho-physical series.

The physiologist, approaching similar problems, tends to lay chief stress upon the response side of the stimulus reaction situation. He legitimately isolates this so far as possible, often cutting it out of its wider organic setting, and shrinking from speculation about central processes until he has learned as much as possible about peripheral processes and their mode of operation. The experimental psychologist has often tried to borrow the physiologist's terminology, but since he has to try to deal with the intact organism, the wide variability of response when it occurs in its normal setting constantly forces him back upon central processes, and he may tend to lose himself in sheer speculative physiology of the central nervous system. This is illustrated by a reference to experimental work upon the special senses.

In dealing with so-called 'higher mental processes', the experimental psychologist has again far too often attempted to imitate the methods of older established sciences. Extreme simplification of stimuli has regularly been confused with isolation of response, with disastrous results. This is illustrated by a study of the classical experiments of Ebbinghaus on memory, and by a consideration of experimental work on recognition.

Not only has the experimental psychologist been too submissive to physical and physiological methods, but also he has often been misled by the pursuit of philosophical ideals. The results of experimentation upon some special field of human reaction have frequently been elaborated into very wide systems of explanation which claim a finality that they certainly do not possess. This is considered in reference to contemporary movements, and particularly to the work of the *Gestalt* psychologists, of Prof. E. R. Jaensch, of Prof. C. E. Spearman, and of the behaviourists.

In psychology, the experimentalist is attempting to find out the conditions of the various responses or modes of conduct that make up the lives of animals and human beings. He is primarily interested in the intact organism and the intact mental life. He may gain help from a study of instances in which certain types of response have been lost, leaving still a very complex organism, or mental life, to effect a readjustment of what remains. This is clearly a very different matter from cutting out the partial response and studying that by itself. The perfecting of objective control, in a psychological experiment, does not reduce the observer to a single sense, or a single cognitive or emotional process, but, leaving him as complex a reactive agent as ever, forces him to make up on the spot a type of total reaction fitted to this special experimental environment.

The main conclusions drawn are: (1) The experimentalist in psychology is at present, and perhaps always will be, as much clinician as experimenter. He must bear in mind that the conditions of all reactions studied from his special point of view branch very widely, and that to him the study of indirect cues leading to any response may be of primary importance. (2) No experimentalist in psychology must profess, with unvarying belief, the dogma of constancy of objective conditions. Many of the most important characters that dominantly set the course of human reactions belong directly to the organism with

which the experimentalist is dealing, to its immediate and remote past history, and to its present specific and general state of adaptation. These characters may be more diversified by rigidity than by variation of outward circumstances. (3) Since the psychologist is dealing with biological phenomena, he must be satisfied by stating trends, directions, proclivities, rather than dogmatic laws. (4) There is need for much more critical care than has usually been exercised before the results of specialised investigations are erected into comprehensive 'explanatory' systems.

If these conclusions are held firmly in mind, experimental psychology will yet prove equal to its task of building up a sound scientific study of complex response in animal and man.

Modern Movements in Education.

In his presidential address to Section L (Educational Science), Dr. C. W. Kimmins deals with changes in the field of education since the meeting of the British Association in South Africa in 1905. The most important development during this period has been the concentration of interest on a hitherto comparatively neglected field of investigation—the mental welfare of the pre-school child. In this connexion a brief account is given of the valuable researches on animals of Köhler and Yerkes, which throw much light on the early stages of the learning process in the child. The necessity of making the young child the object of a long series of conditioned experiments—even if this were possible—is thus obviated.

Reference is made to the great difficulty of bridging the gulf which separates the child's world from the adult world, and of thus acquiring a fairly adequate conception of the real meaning of the child's language in adult terms. The value of the work of Prof. Jean Piaget and his colleagues in helping to solve this problem is fully recognised by all students of child-psychology.

When the age is reached for compulsory school attendance, and there becomes available a large mass of valuable material for observation and experiment, the task of the investigator is rendered a comparatively easy one. In the pre-school period, however, the absence of such material under suitable conditions is a serious matter. The Fisher Act of 1918, with the prospect of the establishment of a large number of nursery schools, gave promise of removing this disability, but, unfortunately, financial difficulties prevented the full realisation of this desirable project.

Quite apart from the value of the nursery school for purposes of child study, there are many obvious reasons for pressing forward the demand for the recognition of this type of institution as a natural element in any progressive scheme of educational organisation. The nursery school links up the home with the school to the great advantage of both. Properly constituted, moreover, it may to a large extent prevent many of the maladjustments with which the school clinics and child guidance clinics have to deal. Prevention by natural means is infinitely better and far less expensive than curative processes.

The value of vocational guidance by means of appropriate psychological tests, in giving increased facilities for the more successful marketing of the produce of our schools in the future, is dealt with in some detail. The experiments carried on under the direction of the National Institute of Industrial Psychology have been crowned with considerable success. In days to come, boys and girls on leaving school will be in possession of information, based on scientific principles, which will indicate the type of employment in which they can engage with the greatest satisfaction to themselves and to their employers.

The pamphlet of the Board of Education entitled "The New Prospect in Education" is far and away the most important document which has been issued by the Board in recent years. The reorganisation of educational procedure envisaged marks a great advance. This valuable reform occupies in many ways a very prominent and honoured position among modern movements in education.

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America may be held to militate against its American origin and rather support the view that it was an introduced plant. Further evidence in support of the eastern origin of the coconut and also of its power to spread independently is afforded by the fact that several islands all grouped together bear the name Cocos Island or have a 'Cocos Bay'. These islands were apparently uninhabited at the time of their discovery and received their names no doubt owing to the fringes of coconut palms on their shores, as it was the tendency of the Portuguese and Dutch in the sixteenth and seventeenth centuries to name uninhabited islands by some distinguishing feature they presented.

Another fact which lends some support to the views of De Candolle, Beccari, Chiovenda, E. D. Merrill,[11] and others, that *Cocos nucifera* is of eastern rather than American origin, is afforded by the recent discovery of fossil nuts of a *Cocos* in the Pliocene deposits at Mangonui, North Auckland, New Zealand. These have been named *Cocos zeylandica* by Edward W. Berry,[12] and, though they are quite small, they show no marked features, except as regards size, to differentiate them from the existing genus *Cocos*.

O. F. Cook has taken infinite pains to try to prove that the Coconut palm originated in South America, but many of his arguments may equally well be used in support of its Polynesian origin. With regard to the antiquity of the palm in America, he lays some stress on the finding of a carved coconut shell in a grave in the Chiriqui district on the Pacific coast of Panama. This bowl is figured in Cook's "History of the Coconut Palm in America",[13] but it is not stated whether the grave was a prehistoric one or not. I am informed by the authorities at the British Museum that the design on the carved shell is certainly not aboriginal American, nor does it resemble anything from the East Indies at all closely. It is considered far more likely to be "a post-Spanish American product influenced by European designs such as were used by Indians in many parts of America after the arrival of the white man".

The highly polished coconut cups of Spanish South America are mentioned as a suggestive analogy, and also the similar floral patterns of modern Indian painted pottery, etc.; it is not thought that the carved shell carries any weight as evidence either for or against the American origin of the coconut palm.

The fact of the finding of some particular bowl in a country needs some further support in the way of evidence, to prove that it may be a product of the country where it has been found, since a good deal of false deduction might be based on the finding of shells of the double coconut (*Lodoicea*), in India, where they are used as drinking bowls and for other purposes.[14] Cook also attaches importance to the occurrence of coconut palms on Cocos Island, situated in the Pacific Ocean some 300 miles to the west of Panama, which since the coming of the Spaniards has not been inhabited and the coconut palms have almost disappeared. After considering the various suggestions made by Cook, there seems to be nothing against the view, held by De Candolle, that the coconut palms on this island might have been brought there by early Polynesian voyagers. From this island, or more possibly by the landing of some of these early voyagers on the Pacific coast of Central America, they became established on the mainland and were in the course of time carried far and wide.

Mr. H. C. Sampson, who carefully studied Cook's work, has kindly supplied me with the following notes:

The three main points raised by Cook are:

1. That the coconut must have plenty of soda salts for it to thrive. Therefore it must be a native of those parts of America where such alkali abounds in the soil.
2. That the coconut will not establish itself on a coast-line without the aid of man.
3. That the fibrous covering on the coconut is intended to hold a supply of moisture for the roots of the young seedling and not to act as a float.

As to 1. Coconut palms are able to stand a high percentage of soda salts in a soil provided there is very free drainage and aeration. Where these are absent the tree immediately becomes unhealthy. Tidal action on a sandy sea coast supplies the necessary drainage and aeration, hence trees on a sandy sea coast are usually healthy, while those facing a lagoon or backwater are unhealthy. Health, according to Cook, is the ability to form fruit; but this is not so. Healthy trees need never bear fruit. They will, however, bear fruit if the necessary plant food is made available to them in the soil. Coconuts will grow quite well in soils deficient in soda salts. This has been proved by the Bombay Department of Agriculture, when the Government of that Presidency was considering the question of remitting the duty on salt required for the purpose of manuring coconut trees in the Konkan and in North Canara.

I myself have seen coconuts doing very badly on soils which were inclined to be alkaline, though the trees were afterwards made to bear heavily by breaking up the alkaline pan, which one usually sees associated with such soils.

With regard to 2. I have seen self-sown coconuts establishing themselves on the cays off Belize which are being formed in the shallow water. The young palms are able to compete for light with the young mangrove which under such conditions is inclined to remain stunted. The coconut groves on the east coast of Trinidad in the region of the Cocal are undoubtedly self-sown. These are said to have originated from the wreck of a French schooner laden with coconuts. One sees the trees growing in clumps often four or five together or in close proximity, which would not be the case had they been planted by man. That coconuts do not do this more frequently is due to two causes: First, that though the seed may germinate it cannot survive where the shore vegetation is liable to overshadow the seedlings, and secondly, in the open

[11] Merrill, E. D. "Enumeration of Philippine Plants", Bureau of Science, Manila, vol. 4, pp. 70-71 (1926), also "Notes on the Flora of Manila with special reference to the introduced element", *Philippine Jour. Science*, vol. 7, pp. 168-192, 197, etc. (1912). Dr. Merrill informs me he has now altered the views expressed in his footnote on p. 192, and does not agree with Cook as to the American origin of the coconut.

[12] Berry, E. W. *American Jour. Science*, **12**, No. 69 (September 1926). Specimens of these nuts were kindly sent to Kew in March 1927, by the curator of the Auckland Museum and are now exhibited in Museum No. 2.

[13] Cook, O. F. l.c., Plate 53, p. 288; 1910.

[14] See "Treasury of Botany" and Kew Guide to Museum 2 and specimens in the Museum.

glare of an exposed beach it is not possible for the husk to retain sufficient moisture to enable the young roots of the coconut to feed on the husk.

With regard to 3. It is very difficult to get coconuts to germinate in a dry climate without initial shade and constant watering. The fruit when it is ripe gives up its moisture from the husk, and it can only get this again by coming into direct contact with moisture either from the soil or from continual rain. Thus on the sandy coast soils of Ceylon and southern India, seed coconuts have to be nearly buried in the sandy soil, which has to be kept continually moistened, and even under such conditions germination is much slower than it is in countries with a more evenly distributed and heavier rainfall.

It is clear that natural regeneration would be impossible for the coconut in a dry country such as Cook claims to be the natural home of the coconut. It seems to me much more likely that the coconut was taken to America by immigrants arriving there prior to the discovery of that continent by western civilisation than the reverse.

Turning now to the mode of dispersal of the coconut:

The sight of the Cocos-Keeling Islands, or Atolls, in mid-ocean on the direct route from Ceylon to Western Australia, and some 700 miles to the south-west of Java and the Straits of Sunda, led me to look into the early history of these Islands and search for records of the occurrence of coconuts on other uninhabited islands in the Pacific Ocean.

Coconut palms were well established on these uninhabited Islands when Captain Le Cour visited them in 1825,[15] before Captain Ross arrived there that same year, for he "carved his name on the Palm trunks". H. B. Guppy brings together some very interesting evidence in connexion with the coconuts growing on the Cocos-Keeling Islands.[16] In a general map of the Eastern Archipelago, published in Amsterdam in 1659, they are named the Cocos Islands, showing that the coconut palm was then a feature of the group. Again, in Jan de Marre's plan of the islands in 1729, coconut palms are figured with the simple, yet probably unintentionally true, remark: "it would seem that Nature herself has produced these trees", and in 1753 Van Keulen described them as being wooded.[17] Further, some fifteen or sixteen years before the islands were occupied (see Horsborough's "India Directory", 1809), it is stated that they were "covered with trees, principally the Cocoa-tree" (=coconut palm).

Charles Darwin visited the Cocos-Keeling Islands[18] in the year 1836, some ten years after their rediscovery, and found them thickly covered with full-grown coconut palms. He points out that at one time they must have existed as mere water-washed reefs, and therefore "all their terrestrial productions must have been transported by the waves of the sea". It is also of interest that Darwin refers to the occurrence of *Birgus latro* on these islands, and this suggests that both coconut and crab were brought to the islands by the same means.

From this evidence it appears certain that the coconut palms on the Cocos-Keeling Islands were established there when they were uninhabited, and there is also strong probability that they were the result of ocean-borne nuts which had drifted there, with many other seeds from the east, as Guppy points out. From information kindly supplied by the Hydrographer to the Royal Navy, I find that the general trend of the ocean currents in this region is from the east, westwards, so that any flotsam and jetsam reaching the islands would tend to come from Java or Sumatra or from the Sunda Straits.[19] It seems not unreasonable to assume that the original nuts which have given rise to the coconut groves on the Cocos-Keeling Islands reached there as ocean-borne nuts from the islands to the east, and this supposition may be held to give some additional support to the view that the islands of

FIG. 1.—Young coconut among *Ischæmum muticum*; background, *Desmodium umtellatum*. Krakatau.

the Eastern Archipelago of the Pacific Ocean should be regarded as the original home of *Cocos nucifera*.

It is, of course, true that young sprouting coconuts on the strand are constantly destroyed by the land crabs, but it seems not unreasonable to assume that a few nuts, out of the many which must have been washed ashore, would have been covered by drift sand and so protected from the land crabs, and that from those which successfully germinated the dense groves of coconut palms on these and on other uninhabited islands had their origin.

Wood-Jones mentions that water-borne coconuts can be seen germinating all round the lagoon shores of Cocos Island, and adds there is "no reason to suppose that any human agency was involved in the first planting of the coconuts in Cocos-Keeling".

The coconut palms now growing in the Bay of Cocal, Trinidad, are reputed to have resulted from nuts washed ashore from a ship wrecked on the coast, and also, as mentioned earlier, on some of the cays which are being formed off the coast of British Honduras self-sown coconuts may be seen.

[15] See Wood-Jones. "Coral and Atolls", p. 5, p. 17; 1912.
[16] Guppy, H. B. "The Dispersal of Plants as illustrated by the Flora of the Keeling or Cocos Islands, Victoria Institute" (1890), pp. 2-5.
[17] Van Keulen's "Atlas", vol. 6, Amsterdam, p. 19; 1753.
[18] Darwin, Charles. "Voyage of the *Beagle*", chap. xx.
[19] Darwin, in the "Voyage of the *Beagle*", quotes Holman's "Travels", vol. 4, p. 378, where an account is given, on the authority of Mr. Keating, of seeds, etc., from Sumatra and Java, washed up on the Cocos-Keeling Islands. Among them were "the cocoa-nut of Balci, known by its shape and size".

Coconut palms are also found on small rocky islets off some of the Fiji Islands, where evidently the nuts have been cast up by the sea and could never have been planted.

Guppy, in his paper on the Cocos-Keeling Islands (*loc. cit.*), produces weighty evidence to show that the coconuts there must have been water-borne and have germinated when washed up on the strand. He also brings evidence in support of the contention that the coconut is able to germinate without human intervention when washed up on Fijian beaches, whether brought down by a river or transported by an ocean current.[20]

Leguat, in his account of the Island of Rodriquez (1691),[21] says: "The sea having thrown us up some Cocos which began to bud, we planted some of the fruit some months after our arrival, and when we left the place the trees were four feet high." These nuts he believed came from the Island of Ste. Brande. There are also two islands called Coco and Cocos in this region.

A definite proof that the coconut will germinate unaided when washed ashore has been afforded in the case of the Island of Verlaten, which lies to the north-west of the Island of Krakatau in the Straits of Sunda, between Java and Sumatra. Verlaten Island, which is uninhabited and uninhabitable, was visited in April 1919 by Dr. W. Docters van Leeuwen, now Director of the Botanic Gardens, Buitenzorg, and he records,[22] with a photograph, the finding there of a coconut palm sprouting in the drift mud—an accretion of soil containing pumice stone—at only a few yards distance from the sea. This proves conclusively that an ocean-borne coconut can germinate without human aid, as Beccari asserted, and refutes the opinion of Hugo de Vries, O. F. Cook, and others.

When I was in Java in March 1928, Dr. Docters van Leeuwen very kindly gave me prints of two photographs of two young coconut palms, similar to the one on Verlaten, which he found growing on the beach of the Island of Krakatau (Fig. 1), which since the great eruption of 1883 has remained uninhabited. In one case the young palm is partly overgrown by *Ipomœa denticulata*; in the other, here reproduced, the palm is growing amongst the grass *Ischæmum muticum* and, despite the competition with other vegetation, they both appear to be holding their own quite successfully. These observations afford satisfactory evidence that ocean-borne nuts can germinate when washed ashore on an uninhabited island and become established without the intervention of human agency, and the evidence which has been brought forward may be considered to strengthen the view that the Polynesian or East Indian Islands are the original home of the coconut palm.

[20] Guppy, H. B. "Observations of a Naturalist in the Pacific", vol. 2, p. 436.
[21] "The Voyage of Francois Leguat", vol. 1, p. 65 *et seq.*, Hakluyt Society.
[22] Docters van Leeuwen, Dr. W. *Ann. Jard. Bot. Buitenzorg*, **31**, p. 114, Plate xxi.

Obituary.

PROF. L. T. HOBHOUSE.

THE death of Prof. Leonard Trelawny Hobhouse on June 21, at the age of sixty-four years, at Alençon, Normandy, is a heavy loss to science and philosophy. Martin White professor of sociology in the University of London since 1907, he has done more than anyone else in England towards the development of sociology as a scientific discipline; he has made contributions of the highest value to comparative psychology and anthropology; and his work on logic and metaphysics must entitle him to rank among the most distinguished systematic philosophers of recent times.

Already as an undergraduate at Oxford, Hobhouse was led through his interest in social reform to a deeper study of the nature of society and its relation to the wider problems of metaphysics, and throughout his life his scientific and philosophical researches were closely and intimately interwoven with his work as a politician and practical reformer. His passion for humanity and justice gave him tremendous driving power, while his love of truth and rare intellectual candour and willingness to profit from criticism and experience led him to ever fresh fields of investigation and ever deeper analyses of the foundations of knowledge. He illustrates in his life-work his own view of reason as a continuous and comprehensive effort towards harmony in experience whether in the fields of practice or speculation, and those who saw him at work, whether as a teacher, journalist, or chairman of trade boards, will have recognised in his endeavours the very same spirit which in other fields was exhibited in his persistent attempts at wider and more inclusive syntheses of the results of empirical research and metaphysical speculation.

Hobhouse laid his foundations solidly in an early work on the "Theory of Knowledge" (1896), in which he developed what may be termed an organic view of rationality which was to be the basis of all his future work. This has affinities with idealistic metaphysics but is essentially realistic. Hobhouse, indeed, may be regarded as one of the founders of modern realism, but unlike some of its more recent upholders who tend to reduce the cognitive function to a vanishing point, he seeks to vindicate the reality of mind as well as of the external world, of the self as well as the not-self, the conception of the self being built up by the same logical processes as go to the making of any other valid conception.

From his epistemological investigations Hobhouse turned to empirical research. In his "Mind in Evolution" (1901) he traces the growth of mind in the various forms of organic life, from its earliest manifestations in the gropings of unconscious effort to the full clearness of conscious purpose. This work was based on extensive experimental investigations, now generally regarded as among the most important pioneer contributions to the science of

comparative psychology. Moral and social development were then studied in his "Morals in Evolution" (1906), in which he utilises on a magnificent scale the data of anthropology and history in the establishment of a social morphology indispensable to the evolutionary point of view in sociology.

Armed with the conclusions derived from these researches into empirical fact, Hobhouse returned to the metaphysical problem in his "Development and Purpose" (1913; revised and rewritten in 1927). He shows that development consists in the extension of harmony through a series of syntheses. Development proceeds by the liberation of elements originally in conflict, the building up of structures of varying degrees of plasticity and coherence. The power behind this liberation and these syntheses is mind, essentially a correlating activity, manifested in all orderly structure, but more clearly in living organisms, which are interpreted as a modification of mechanical structure by teleological factors, and eventually emerging in the form of conscious purpose in the human mind, as expressed in the advancing movement of civilisation. Mind is, on this view, not coextensive with reality, but is the principle of orderly growth within it. It is limited by the material it works upon, and its purposes themselves undergo development. His fundamental principle, which he entitles 'conditioned teleology', is examined both from the point of view of the logical requirements of systematic explanation and its value as an instrument in scientific investigation in the fields of biology and sociology.

In a further series of works collectively entitled the "Principles of Sociology" (1918–1924), Hobhouse sought once more to apply his basic conception of mind as a correlating agency to the problems of social life. In the first of these, "The Metaphysical Theory of the State" (1918), he gave what is now generally regarded as the most penetrating criticism of the Hegelian theory of the State and prepared the ground for a social philosophy which would do justice at once to individual development and the requirements of the common good. In the "Rational Good" (1921) he works out his ethical theory of the good as a harmony of mind with its objects, a consilience of all living experience in a comprehensive system of purposes. In the "Elements of Social Justice" (1922) he applies these ethical ideas to the problems of social organisation and proves their value by the light which he is able to make them throw upon the practical problems of economics and politics. Finally, in his "Social Development" (1924) he gives us a synthesis of his scientific and philosophic studies bearing on the human problem. He first studies development from the point of view of empirical science and seeks to correlate the several aspects of social change in the light of non-ethical criteria analogous to those that might be employed in the study of biology. He then turns to the ethical problem of valuation, and finally argues that social and ethical development have a common end, rooted in the fact that the good is to be found in organic harmony. Taken together, these works must assuredly come to be recognised as the most comprehensive and scientific attempt that has yet been made to trace out the working and possibilities of rational purpose in human evolution.

Prof. Hobhouse was profoundly interested in the bearings of recent developments in the physical sciences upon the nature and validity of knowledge, as will be evident to readers of the revised edition of "Development and Purpose". He intended to devote himself on retiring from the chair of sociology to work on these problems. His sudden death has deprived the world of the results of his ripe speculation in this field of thought, and this can only deepen our sense of the loss of a great thinker, distinguished alike by a rare nobility and beauty of character, and by magnificent intellectual grasp and power.

MORRIS GINSBERG.

WE regret to announce the following deaths:

Sir Baldwin Spencer, K.C.M.G., F.R.S., emeritus professor of biology in the University of Melbourne and author, with F. J. Gillen, of works on the Australian aborigines, aged sixty-nine years.

Dr. W. J. Viljoen, Superintendent-General of Education of the Cape Province and first vice-chancellor of the University of South Africa, aged fifty-nine years.

News and Views.

IN his presidential address to the British Medical Association, delivered at Manchester on July 23, Prof. A. H. Burgess reviewed some aspects of the influence of other sciences upon the practice of modern surgery. The era of 'modern' surgery was inaugurated by Lister, and the present use of aseptic methods is merely the natural advance from the antiseptic technique as originally practised: antiseptics are still used for cleansing the skin and when sepsis is already present. As a sequel to the safety engendered by the use of these methods, the surgeon has access to all parts of the body, the spinal canal and thoracic cavity as well as the abdomen. Perhaps surgery is most indebted to the two sciences of physics and physiology during more recent years: it is only necessary to mention the aid brought by radiology, and radium and light therapy, by localisation of function in the brain, by the use of blood transfusion, by the discovery of vitamin D and insulin, and by the development of biochemical methods of investigating the body's functions. Prof. Burgess recalled in some detail the influence which these various discoveries had exerted upon surgical treatment. X-rays were first used in the accurate diagnosis of injuries to the bones and in diseases of the chest, the bones being relatively opaque and the lungs transparent: where the density of neighbouring tissues is similar, it is now the practice to administer or inject either a substance which is opaque to the rays, or air, which is transparent, and so by displacing tissues or tissue fluids enables a differentiation of the organ under examination to be made from the

neighbouring tissues. In Manchester, 20 per cent of patients pass through the X-ray department as compared with 1 per cent twenty years ago.

THE use of radium in treatment has had a twofold influence on the surgeon: it has sometimes replaced treatment by the knife, but at others a surgical approach to the seat of disease is necessary before the radium can be usefully applied. At the present moment, opinion seems to favour reversion to the external application of radium, but using relatively enormous quantities and at a much greater distance from the skin. The practice of actinotherapy has revolutionised the treatment of surgical tuberculosis, in which disease surgical removal of damaged tissues has been replaced by immobilisation and drainage, whilst the general resistance of the body is increased by its exposure to the sun or other source of light. The story of the development of our knowledge of the localisation of function in the brain illustrates the mutual reactions of clinical medicine and experimental physiology upon one another. The first step was clinical, the localisation of the speech area by Broca and the motor area by Jackson, and was followed by the experimental investigations of Ferrier, Horsley, Sherrington, and others, so that to-day the diagnosis of the site of an injury to, or lesion of, the brain is quite precise. A similar interplay of medicine, pathology, and physiology is seen in the development of our knowledge of the functions of the thyroid gland. Work such as this and other recent advances in treatment based on joint clinical and experimental investigations serves to show the importance of co-operation between clinicians and experimentalists.

A MEMORIAL tablet to Sir Humphry Davy has just been unveiled in the Pump Room of the Wirer Endowment at Ischl in Austria, to commemorate his stay at that watering-place. The ceremony was performed in the presence of a distinguished party, including the Austrian Chancellor, Dr. Streeruwitz, who in a speech dwelt upon the gratitude the world owes to the inventor of the miner's safety lamp. It was on May 26, 1818, that Davy embarked at Dover for Naples, whither he was going to study the problem of unrolling the papyri found at Herculaneum. His journey took him up the Rhine and Danube into Austria and Hungary, and on this journey he took the opportunity of making observations of the formation of mists over rivers and lakes, which at that time was not understood. The rivers he studied included the Inn, the Ilz, the Raab, the Save, the Ironzo, the Po, and the Tiber, his results being contained in his paper to the Royal Society of Feb. 25, 1819, entitled "Some Observations on the Formation of Mists in Particular Situations".

THE scientific work of the Czechoslovak biologist, J. E. Purkyně (Purkinje), like that of many other pioneers, has largely escaped attention, although a number of men of science have, from time to time, referred to the importance of his contributions to many branches of biology. Purkinje was born near Prague on Dec. 17, 1787, and died there on July 28, 1869, and on the occasion of the sixtieth anniversary of his death, Dr. O. V. Hykeš has collected and issued in pamphlet form ("Přírodovědecké práce J. E. Purkyně") a selection of comments and appreciations of his work by well-known biologists. Purkinje's researches cover subjects in microscopic anatomy, cytology, neurology, the physiology of vision and of the ear, biochemistry and anthropology. An American writer in 1899 declared that Purkinje, under the most unfavourable conditions, had laid the foundations for modern physiology. Although the compound microscope had been in use for nearly a century, his discoveries, up to 1830, were made with the aid of simple lenses, yet he was the first to use the microtome. When unable to pursue a subject exhaustively, Purkinje time and again pointed the way to a noteworthy discovery. He was the first to employ the term protoplasm and to establish the identity of structure in plant and animal cells. Purkinje's work has hitherto attracted most attention in Germany and Scandinavia.

IT is generally recognised that while many local museums include a number of objects illustrating the life of the population of the area in medieval and later times, an urgent need is a national museum for England which will illustrate the traditional arts, industry, and life generally of the folk. Wales already has a national museum of this character, and there are similar collections in Ireland and Scotland. The matter is undoubtedly one of some urgency, as objects of the character contemplated are becoming more and more difficult to obtain every day. The council of the Royal Anthropological Institute, having these facts in view, has appointed a small committee to consider the position. Lord Onslow, Sir Henry Miers, and Dr. R. E. Mortimer Wheeler have accepted appointment to the committee. The Royal Society, the Zoological Society, the Society of Antiquaries, the Folklore Society, and other interested bodies have nominated, or have been invited to nominate, representatives to sit on the committee. It is hoped to hold a conference to discuss ways and means early in the autumn.

A COMMITTEE has been formed to establish a Memorial Fund with which the name of the late Prof. L. T. Hobhouse may be permanently associated, to be used to assist in the perpetuation of his influence. The committee consists of Prof. S. Alexander, Sir William Beveridge, Mr. Victor Branford, Dr. Morris Ginsberg, Dr. G. P. Gooch, Mr. J. L. Hammond, Mr. J. A. Hobson, Prof. Gilbert Murray, Prof. Percy Nunn, Sir Herbert Samuel, Mr. C. P. Scott, Sir Hubert Llewellyn Smith, Sir Arthur Steel-Maitland, Prof. Graham Wallas, and Mrs. Beatrice Webb, and subscriptions may be sent to Dr. G. P. Gooch, 76 Campden Hill Road, London, W.8. It is hoped that subscribers may leave it to this widely representative committee to frame a scheme for the memorial and to decide at a later date whether the fund raised can be best used for a lectureship, scholarship, or the publication of studies in the social sciences. Dr. Morris Ginsberg, London School of Economics,

Aldwych, W.C.2, has agreed to act as honorary secretary of the Fund.

AN interesting suggestion for a possible origin of early Mesopotamian culture is put forward by Mr. Henry Field, of the Field Chicago Museum, in the *Times* of July 17. As a result of recent archæological survey work conducted by the Marshall Field North Arabian Desert Expeditions, it would appear that the North Arabian and Syrian deserts, which in palæolithic times were well watered, then supported a considerable semi-nomadic population, of which traces have been found in the form of palæolithic implements on several hundred sites. These range from Upper Chellean, found *in situ* at a depth of 11 feet 6 inches, to Upper Palæolithic. It is suggested that at about the time of Cro-Magnon man in western Europe, the desiccation of the North Arabian area began, and finally drove the population, by that time in a neolithic stage of culture, westwards to the Nile Valley and eastwards to Mesopotamia, where they constituted the earliest inhabitants. On the evidence of the earliest skeletal remains found in the lowest levels of Kish, it would appear that the earliest inhabitants of that area may well have been direct descendants of the Palæolithic and Neolithic peoples of the North Arabian desert.

PROF. S. LANGDON, who forwards Mr. Field's letter to the *Times*, adds a much-needed caveat. While recognising the importance and the significance of the discovery of this extensive palæolithic culture of the Syrian desert, he hesitates to accept it as the source of Sumerian or prehistoric Mesopotamian culture. As he points out, it raises the question whether this culture is to be attributed to the Sumerians of Elam and of Central Asia and of the Indus Valley or to the Semites of Akkad. The excavations at Kish and Jemdet Nasr appeared to have settled this question definitely in favour of the proto-Sumerian Elamite people. Prof. Langdon emphasises the significance of the fact that while no painted pottery has been discovered in the Syrian desert within 2000 years of the date of that at Kish, in Elam and Central Asia, at water level at Kish and at plain level at Jemdet Nasr, the painted ware is accompanied by epigraphical material, seals and copper of undoubted Elamitic affinities which would all point to the proto-Sumerians of the east as the founders of this civilisation. Mr. Field's interesting suggestion may well serve to throw light on the early migrations of the Semitic peoples. It fails to withstand the weight of the evidence to which Prof. Langdon refers, which is all against a Semitic origin for the earliest culture of Mesopotamia.

THE following elections have been made to Beit Memorial Fellowships for Medical Research, the place of research being given in brackets: *Fourth-year Fellowships* (value £500 per annum): Mr. R. J. Lythgoe and Mr. M. W. Goldblatt. *Junior Fellowships* (value £400 per annum): Mr. R. Hill, to investigate the specificity of hæmoglobins and the properties of cytochrome (Biochemical Laboratory, Cambridge); Dr. Ann Bishop, to complete the study on which she has been engaged during last two years of the morphology and development of *Trichomonas* of man and monkeys (macaques) in culture and to investigate other intestinal protozoa (Molteno Institute for Parasitology, Cambridge); Mr. C. L. Cope, to study the diuretic responses of normal and pathological kidneys in man to tubule diuretics (Department of Medicine, Oxford University); Dr. L. E. Bayliss, to study the metabolism of the isolated heart and kidney by means of the heart-lung and heart-lung-kidney preparation and by means of the artificial oxygenator of Bayliss, Fee, and Ogden (Department of Physiology and Biochemistry, University College, London); Dr. W. P. Kennedy, to investigate the function of the ovary (Physiology Department, Edinburgh University, and Royal Infirmary, Edinburgh); Mr. E. Boyland, to investigate the mechanism of carbohydrate metabolism, with particular reference to the phosphoric esters of yeast and muscle (Lister Institute, London); Mr. E. M. Case, to study the metabolism and thermodynamics of muscle by means of a comparative study of alcoholic fermentation by yeast and lactic acid production by muscle, and by means of a new apparatus to investigate the thermal properties of so-called 'non-irritable' muscle, concurrently with chemical analyses (Sir William Dunn Institute of Biochemistry, Cambridge); Mr. K. A. C. Elliott, to undertake studies on biological oxidations such as the oxidation of metabolites by various thermolabile and thermostable peroxidases (Biochemical Laboratory, Cambridge); Miss M. H. Roscoe, to continue investigations on the distribution of the antipellagra vitamin B2 in natural foodstuffs and a comparison with the distribution of the anti-neuritic vitamin B1 (Lister Institute, London).

IN honour of the sixtieth birthday, on June 27, of Prof. Hans Spemann of Freiburg, a special number (Heft 25) of *Die Naturwissenschaften* has been issued. A portrait of Prof. Spemann precedes an article of half a dozen pages in which Dr. Otto Mangold gives an account of the main lines of Prof. Spemann's work and the results achieved. This is followed by a list of Prof. Spemann's publications from 1895 until 1929, and by a list of important investigations carried out by pupils and collaborators in more or less close relation with their master, and finally by a series of abstracts, by the respective authors, of the memoirs which form the recently published five-volume 'Festschrift' in honour of Prof. Spemann in *Roux's Archiv für Entwickelungsmechanik* (Bände 116-120). This massive 'Festschrift' and the special number of *Die Naturwissenschaften* are well-merited tributes to one who is held in the highest esteem not only for his manipulative skill, his keen powers of analysis and interpretation and his lucid exposition, but also for his great personal qualities.

THE Department of Mines of the Dominion of Canada has issued its customary Annual Report for the year ending Mar. 31, 1928. This report gives evidence of the great advances made in all departments of the Canadian mineral industry. This is sufficiently shown by the fact that the value of the mineral production of Canada has quadrupled since the year 1900. A matter of special interest in this

report is the reference to the memorial tablet erected by Mr. Fenley Hunter of New York City to the late Dr. George M. Dawson, at one time Director of the Geological Survey of Canada. All who either remember Dr. Dawson personally or who appreciate the admirable work which he did for the Canadian Geological Survey will be pleased to learn that this permanent memorial to him has been erected on an exceptionally suitable spot, namely, on the bank of the Liard River, just north of the boundary line between British Columbia and Yukon, in the delimitation of which Dr. Dawson's surveys have played so conspicuous a part.

THE Annual Report for 1927–28 of the Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington details very numerous, varied, and important work in the domain of terrestrial magnetism and electricity. The non-magnetic ship *Carnegie* was being prepared for the world-cruise now in successful progress. Owing to this the amount of field work on land was severely curtailed, but the Department carried on land observational work at its two important observatories at Huancayo, Peru, and Watheroo, Western Australia. In addition, many interesting investigations, both experimental and theoretical, were made in regard to problems of atomic magnetism, terrestrial magnetic variations, wireless propagation, the high-frequency permeability of iron, and other related topics.

IN order to centralise and arrange a methodical plan for the scientific work which is carried on in northern Norway, Svalbard, Jan Mayen, and the Arctic Sea, a Central Committee for the Scientific Institutions at Tromsö has been recently constituted, the statutes for which have now been sanctioned by the Department of Education. According to Northern News Service, the Geophysical Institute at Tromsö will act as a weather-forecasting and aurora observatory, and Prof. Krogness will have the assistance of Prof. Vegard and of other scientific men working in the north, including Mr. Soot-Ryen, who has made valuable researches into the fauna of the coasts of northern Norway. The committee's aim is to forward co-operative work between the different scientific institutions of Tromsö and the north.

ON July 19, Sir Thomas Middleton unveiled at Dishley Grange, in Leicestershire, a memorial to Robert Bakewell (1725–95), the pioneer of stock-breeding. The movement to commemorate the great English farmer was started by Prof. Scott Watson, of the University of Oxford, who had raised money in both Canada and America for the purpose. In his address Sir Thomas Middleton said that the prosperity of the nineteenth century was largely due to improvers, such as Bakewell, in the preceding century, and that his methods had influenced and are influencing stock-breeding throughout the world. Bakewell with great foresight realised that the need of the future was beef and mutton to feed the rapidly increasing town populations, and that this problem could best be met by breeding the right type of stock. Without some new means of providing meat, the industrial expansion would have been impossible. Before his time, animal breeding had been carried on in a haphazard fashion with no definite aim behind it, and it was due to the fact that Bakewell started with a clear objective that his enterprise met with such success. His aim was to obtain animals that weighed heaviest, matured earliest, and most quickly repaid the food they consumed. He obtained his best results with sheep, but also applied his principles to the breeding of cattle, cart-horses, and pigs. The prices he secured for the letting of improved sires testify to the esteem in which he was held by other farmers of his day, and the wide application of his methods by others shows that he is rightly to be considered one of the greatest agricultural pioneers of the eighteenth century. After unveiling the memorial, Sir Thomas Middleton placed a laurel wreath on Bakewell's tombstone, which lies in the ruins of the old church.

MR. JOHN PATTERSON has been appointed Director of the Meteorological Service of Canada, in succession to Sir Frederic Stupart, who retired at the end of June, after fifty-seven years' service.

PROF. F. A. E. CREW, of the Animal Breeding Research Department of the University of Edinburgh, has been elected a foreign member of the Czechoslovak Agricultural Academy.

IN view of the long-continued drought in Great Britain, the Ministry of Health has issued a "Memorandum on Water Shortage", suggesting that water authorities should lose no time in scrutinising the position and considering whether any supplementary supplies are available in their neighbourhood. Suggestions are also made for conserving existing supplies by detection and prevention of waste, temporary reduction or intermission of discharges of compensation water, and use of alternative supplies, if any. It is considered that restriction of the supply for domestic use should be resorted to only in cases of actual necessity.

THE following appointments have recently been made by the Secretary of State for the Colonies in the Colonial Agricultural Services: Mr. W. H. Edwards, lecturer in entomology and zoology at the College of Agriculture, and acting botanist and mycologist, Mauritius, to be entomologist, Jamaica; Mr. S. M. Gilbert, superintendent of agriculture, Nigeria, to be assistant director of agriculture, Trinidad; Mr. A. Pitcairn, district agricultural officer, Tanganyika, to be assistant director of agriculture, Cyprus; Mr. J. R. Mackie, superintendent of agriculture, Nigeria, to be deputy assistant director of agriculture, Nigeria; Dr. R. H. Le Pelley, to be assistant entomologist, Kenya; Lieut. J. Eaden, to be assistant manager, Experimental Fruit Farm, Sierra Leone; Mr. H. E. Green, to be inspector of plants and produce, Agricultural Department, Gold Coast; and Mr. E. Lawrence, to be district agricultural officer, Nyasaland.

A RECENTLY issued catalogue of Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, is No. 516, giving particulars of nearly 800

second-hand works relating to the Far East, *i.e.* Japan, China, Korea, Formosa, Siam, Philippine Islands, and the East Indian Archipelago.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master, to teach engineering, at the Rochester Technical Institute and Junior Technical School—The Principal, Technical Institute, Rochester (Aug. 3). A temporary pathologist in the Public Health Laboratories of the County Council of the West Riding of Yorkshire—J. C. McGrath, County Hall, Wakefield (Aug. 3). A lecturer in mathematics in University College, Nottingham—The Registrar, University College, Nottingham (Aug. 5). A university librarian of the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Aug. 10). A head of the Engineering Department of the Smethwick Municipal College—The Director of Education, 215 High Street, Smethwick (Aug. 12). A lecturer in agricultural botany at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Aug. 17). Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage W.C.2 (Aug. 17). Women senior lecturers in botany and microbiology, physics, zoology and physiology, and a lecturer in domestic science, at Huguenot University College, Wellington, Cape Province—The Registrar, Huguenot University College, Wellington, Cape Province, South Africa (Oct. 1). An experimental assistant at the Air Defence Experimental Establishment—The Superintendent, Air Defence Experimental Establishment, The Aerodrome, Biggin Hill, near Westerham, Kent. A woman lecturer in geography or biology with mathematics (subsidiary) at the Bishop Otter Training College for Women Teachers, Chichester—The Principal, Bishop Otter Training College, Chichester. A woman with training in pathology, biology, or physiology, and interested in poultry, for poultry research—laboratory and field work—at the Wellcome Physiological Research Laboratories—The Director of the Laboratories, Langley Court, Beckenham.

Our Astronomical Column.

Large Meteors.—An illustrated article by James Stokley, issued by Science Service of Washington, D.C., describes some of the largest meteor falls on record. There is a striking illustration of Meteor Crater, Arizona, which is 4000 feet in diameter, and strongly resembles one of the smaller lunar craters. It is now generally agreed, from the age of the trees on its rim, that this was formed by the fall of a gigantic meteor, not less than seven centuries ago. A sketch of an equal area located among the sky-scrapers of New York shows what enormous damage might be done by such falls if they came in populous districts. The largest in modern times fell in the Yenisei Province of Siberia on June 30, 1908, when the area affected was 40 miles in diameter; there was great destruction of animals and trees.

Prof. Charles P. Olivier, who is the director of meteoric observation in the United States, is quoted as saying that most of the meteors observed are moving in hyperbolic orbits. This evidently implies a much greater excess over the parabolic velocity than is found in the case of comets; the excess in these is too slight to be detected in the comparatively rough determinations that are alone possible for meteors. Hence the meteors having such speeds cannot belong to the solar system, but are merely passing through it, having had their origin somewhere in the region of the stars.

Dr. W. J. Luyten, stationed at the South African branch of Harvard College Observatory, reports that the great mass of iron recently found in that region is a genuine meteor; he estimates it at 50 tons, which would make it the largest meteoric mass known. The Ahnighito meteor, now in New York, weighs $36\frac{1}{2}$ tons.

Curvature of Space.—The *News Service Bulletin* of the Carnegie Institution of Washington, No. 13, contains an article by Dr. E. P. Hubble describing the further work of Mr. M. Humason and Dr. F. G. Pease at Mt. Wilson Observatory on the radial velocities of spiral nebulæ. Note has already been made in this column of their conclusion that the apparent velocity of recession is proportional to the distance of the object, and is thus evidence of the truth of de Sitter's deduction from the theory of relativity that remote objects should have a displacement of their spectral lines towards the red.

A few months ago the highest velocity found was that of the nebula N.G.C. 7619 in Pegasus, the distance of which was estimated as 25 million light-years; it appeared to be receding at the speed of 2400 miles per second. By using very long exposures, extending to 40 hours, the spectra of three nebulæ in a cluster in Coma Berenices, near the pole of the Galaxy, have now been photographed. The distance of the cluster was estimated, by methods already described, as 50,000,000 light-years; the speeds of recession found are 4900 miles per second for N.G.C. 4860, 4600 miles for N.G.C. 4853, and 3100 miles for N.G.C. 4865. The first two support the theory of speed being proportional to distance; the third does not fit so well. Observations of other nebulæ in the region are planned; it is considered possible that N.G.C. 4865 does not belong to the cluster, but is a small nebula at a less distance.

Period of the Lyrid Meteors.—Mr. Maltzev of Leningrad has been investigating the Lyrid meteoric shower and finds a period of 29·70 years to accommodate satisfactorily some of the observations. He inquires as to where details can be found of the rich display which occurred in 1863, but there seem to be very few accounts of it. However, in the B.A. Report for 1863, p. 325, there is a note on the phenomenon by Prof. H. A. Newton which may be of some use. Mr. W. F. Denning writes that he has tried on several occasions in past years to deduce a period for the shower and found 16·1 years and 29·65 years will conform with a number of the most striking displays. He does not, however, regard them as having a perfectly satisfactory application, for they do not accommodate the various showers in 1803, 1851, 1863, and a few other returns. We require more data, and this may only be obtained by careful watches of the shower in future years. Its exhibitions during the past half a century have generally been somewhat feeble.

Research Items.

A Novel Theory of Animal Evolution.—The problem presented by the inter-relationships between the major groups of animals has been the chief stumbling-block in the path of all theories of evolution. The enormous differences between these groups as they exist to-day make a linear evolution difficult to understand, and the difficulty is increased when it is realised that, so long ago as Middle Cambrian times, the inter-relationships between the different invertebrate phyla were just the same as they are to-day. Austin H. Clark therefore suggests that at the very outset all the numerous phyla came into being not successively but simultaneously by following different paths of development from the single cell—and to this theory he gives the name primagenesis (*Jour. Washington Acad. Sci.*, vol. 10, June 1929). The abrupt discontinuities suggest that each of the phyla represents a re-combination of characters inherent in animals as a whole in a form capable of meeting the requirements of animal existence, both in internal balance and in external contacts. Apparently the focal points at which a balanced condition capable of survival and of meeting competition is attainable are rather few and are well separated from each other, for each of the phyla is widely different from the rest. The flat picture of animal life presented as a result of primagenesis serves as the ground from which various evolutionary trees, one for each phylum, rise upwards through geological time.

Mental Defectives and their Order of Birth.—Two commonly accepted theories tend to place the mentally defective child either at the beginning or at the end of the family succession. That the defective child is the first born infers that mental deficiency is a result of birth trauma ; that it is the last born suggests the result of an exhaustion process. To test these popular notions, Neil A. Dayton has made a survey of 10,455 retarded children in the public schools of Massachusetts (*Jour. Heredity*, vol. 20, May 1929). In order to avoid the possibility of mixed classifications so far as intelligence was concerned, the retarded children examined were divided into two groups by sex, those with an intelligence quotient above and those below 0·70. Relatively twice as many boys (6671) as girls (3739) figured in the examinations. The families analysed contained from two to ten or more children, and the results showed no uniformity. That is to say, there is no evidence that the feeble-minded child tends to be either first or last in the family. If anything, there appears to be a slight tendency for the feeble-minded to occur in the middle of the family, particularly in the larger families. Families having a mentally defective child are larger than families having a retarded child.

Herring Research at Cullercoats.—The Report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending June 30, 1928, drawn up by the Director, Prof. A. Meek, shows a satisfactory progress in the work done, which is mainly the continuation of herring investigations by Mr. B. Storrow, assisted by Mrs. Cowan. Mr. Storrow deals with the shoals involving the examination of some 4000 fish from England, Scotland, and Ireland, and, in addition, about 3000 local fish were examined, and data relating to size, sex, maturity, with scale and age records, were sent to the Ministry of Fisheries. The work on herring shoals was begun in 1919, and an unbroken series of data has been secured up to the present time. In the Yarmouth fishery the 1922 year class with five winter rings is still very abundant, although it has been fished since 1925, which fact points to the original wealth of this year class noted in previous reports and predicted from the presence of young fish in spawning shoals in 1922. In 1927 there were unprecedented numbers of young mature fish with two winter rings, and the product from this spawning may be expected in 1931 in the British fishery. An important point noted in the 1928 local herring is the change in quality. In the previous year many complaints were heard as to the poor quality of the fish taken all along the coast. The season of 1928 shows a considerable difference, the fish having a large amount of fat in the body cavity, the flesh being whiter and the body plumper, with a thicker back than has ever been observed in these north-east coast herring during the past eighteen years. These are more like the celebrated ' west coast herring ' and are splendid eating. Hopes are expressed that biochemical investigations should be undertaken with regard to these changes. In connexion with the scheme of co-ordinated research with the Ministry of Agriculture and Fisheries, Mr. Gill gives a report on the general hydrographical condition of the Northumberland coastal waters in 1926–28.

Protein Metabolism in Plants.—In view of the general interest of biologists and biochemists in protein metabolism, a critical review of our knowledge of nitrogen transformations in plants by Miss M. E. Robinson (*New Phyt.*, **28**, 117-149) serves a very useful purpose. The author emphasises the uncertainty which surrounds even the primary problems in this field, such as the rôle of light in protein synthesis. In the discussion of this question, an interesting fact is recorded. Abderhalden and Rona showed that *Aspergillus* could produce α-amino acids from nitrate and sucrose in the absence of light, while Bayliss remarked on the absence of cyclic compounds in these experiments. Now Miss Robinson states that tryptophane and histidine are formed under these conditions, though doubting whether it is wise to apply such results to higher green plants where light and chlorophyll may be more important. The claim of Hanning that Cruciferæ embryos can synthesise protein in cultures containing peptones and sugars serves as an example of the interesting possibilities opened up by the application of the methods of tissue culture to metabolic studies.

Bourne or Gypsey Flows.—Intermittent streams occur on dip slopes in chalk country, usually after long continued and heavy rains. They are known by different names in various parts of England, lavants in Sussex and Hampshire, nailbournes in Kent, and gypseys in the East Riding. Various theories have been given to explain their origin. In a paper in *Geography* for June, Mr. J. H. Brown describes these streams and discusses the causes of their flow and intermittency. He finds that the determining cause is the existence of underlying gault clay. Normally the rainfall can drain away through the porous chalk, but exceptional rainfall cannot drain in this way. The impervious gault clay holds it until the lower layers of the chalk are saturated. The water table rises, and where the plane intersects the valley slope a spring marks the start of a bourne. Thus a bourne may flow some months after heavy rainfall owing to a comparatively light fall which brings the water table high enough to cut the slope. There is thus no underground channel at the head of these streams. Mr. Brown gives a number of details of various bournes and discusses the reasons for the gradual decrease in their frequence

of flow, which he associates with the lowering of the gault outcrop by denudation.

Temperature Changes in the Lower Atmosphere.—*Geophysical Memoirs*, No. 46, of the Meteorological Office, is devoted to "A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground", by N. K. Johnson (London: H.M. Stationery Office, 1929. 3*s*. 6*d*. net). It describes the construction, use, and results of an apparatus for measuring the temperature at three levels up to 17 metres from the ground. In the discussion, special prominence is given to the daily variation of temperature. In 1915, G. I. Taylor discussed this daily variation, using the Eiffel Tower observations, and assuming that the changes of temperature were due mainly to eddy conduction; but in 1925, S. Chapman showed that in the early morning the air temperature at certain levels on the Eiffel Tower was increasing when eddy conduction would act so as to reduce it; he therefore suggested that the temperature changes were largely influenced by long-wave radiation. This result was criticised at the time, doubt being cast on the value of the Eiffel Tower observations. N. K. Johnson concludes that his observations lend strong support to the conclusion derived by S. Chapman. A further contribution to the subject is made by D. Brunt (*Proc. Roy. Soc.*, A, **124**, 201; 1929), who criticises and modifies the equation of eddy conduction introduced by G. I. Taylor and hitherto generally used; D. Brunt also adds a new term expressing the rate of transfer of heat by radiation.

Drilling for Oil with Diamond Drills.—Of recent years a great deal has been written concerning the advantages of employing the diamond drill on oil-fields, especially for accurate exploratory work. Experience has shown, however, that the diamond drill cannot compete with rotary or standard tools under conditions of ordinary routine production drilling, but this does not detract from its value and application in other circumstances. The diamond drill is invaluable for providing geological information, owing to the continuous cores of rock obtainable by its use; such cores, properly taken, record accurately changes in the formations penetrated, thicknesses, dip, and other structural details; thus, as a test of subsurface structure, the system is probably without parallel. Another useful feature of the diamond drill is its ability to deepen rotary or cable-tool wells the diameters of which have been reduced to the minimum to which those systems have been effective; possibly its employment in the latter connexion has been more commonly sought than in cases of purely exploratory drilling. A thorough account of the diamond drilling system from the engineering point of view was given to the Institution of Petroleum Technologists recently by Mr. G. Haseldin, who based his observations largely on the behaviour of this plant in Algeria, the Punjab, and Assam. It is worthy of note that only a short time before the reading of this paper, Mr. R. T. Banks dealt with the advantages of this system of drilling in the high-pressure gas field of Turner Valley, Alberta, Canada (*Canadian Mining and Metallurgical Bulletin* for February), and recorded the attainment there of a hole more than a mile deep in one instance, also the significant fact that in this field, with only one exception, the diamond drills are operating on wells that have had to be abandoned, for some reason or another, by rotary or standard tools.

X-ray Dosage.—After the adoption of the appropriately named 'Röntgen' as a unit of X-radiation at the Stockholm Congress last year, it was found that it was apparently not possible to reproduce it accurately. The discrepancies between the units of different laboratories, of the order of four per cent, although perhaps not important for most therapeutic purposes, were nevertheless unwarrantably large; the matter has been taken up by the United States Bureau of Standards, and a report upon the problem has now been published in the form of a *Research Paper* (No. 56). It was found immediately that, for accurate work, an X-ray bulb had to be supplied with power from a direct current source of high potential. Precise details of how this can be best effected are given in the report, together with a useful photograph showing the general assembly of the generator. Even then, different saturation currents were recorded if a given ionisation chamber was used with different arrangements of the internal electric fields, and it was finally found to be desirable to resort to a null electrostatic method of measurement, the substantial accuracy of which was shown by the agreement of the results with those obtained by direct measurement with a galvanometer, in cases where the latter instrument could be applied. The error in determining the volume of ionised air has not yet been studied, but apart from this, the accuracy obtainable in the measurement of dosage is now claimed to be one per cent or better.

Sulphur Monoxide.—Prof. V. Henri and F. Wolff have described the production and partial analysis of a new band spectrum associated with sulphur in a recent paper in the current volume of the *Journal de Physique* (p. 81). It appears when a heavy oscillatory discharge is passed through the vapour of sulphur dioxide, extending from about 4000 A. to 2500 A., and has been ascribed to sulphur monoxide, the chemical preparation of which has already attracted considerable attention during the last few years. The usual information concerning the molecule has been deduced from the fine and coarse structure of the bands; the oxygen and sulphur atoms are 1·34 A. apart, and their heat of dissociation is 148 kilocalories per gram-molecule, or a little more than half the heat of dissociation of sulphur dioxide into atoms. The excited molecule of the monoxide appears to be formed directly from the dioxide by electronic impact. Prof. Henri has included some theoretical considerations of a general nature in this paper, pointing out in particular the need for the accumulation of data for the vibrational constants of polyatomic molecules in relation to their structure.

Combustion in Electrical Discharges.—The study of the combustion of carbon monoxide and oxygen in the glow discharge which G. I. Finch and D. L. Hodge have published in the June number of the *Proceedings of the Royal Society* has brought to light some interesting facts concerning the part played by the metal of the cathode. Atoms from the surface of the latter pass into the gas under the influence of the discharge, some metals disintegrating in this way more rapidly than others, and it has now been found that in certain circumstances there is a close parallelism between the rate at which this so-called 'sputtering' takes place and the rate of combustion of the gas in the neighbourhood of the cathode. The metal atoms present in the gas evidently facilitate the union of ions of carbon monoxide and of oxygen, and the picture which is presented of their action is one in which they effectively eliminate the mutual electrostatic repulsion of the ions by forming neutral metal-gas complexes. The evidence upon which this view is based is not merely qualitative, but includes the quantitative correlation of the main facts that have been collected for cathodic combustion on one hand and sputtering on the other, good agreement between the two being obtained on the basis of a few simple

assumptions. Combustion can occur elsewhere in the discharge under the appropriate conditions, and can be accelerated by other means, and the influence of moisture upon its course is to be reported upon later.

The Budde Effect in Bromine and Chlorine.—The effect of water vapour on the Budde effect in chlorine and bromine from which all impurities have been removed has been investigated by G. B. Kistiakowsky, whose results are described in the *Journal of the American Chemical Society* for May. The temperature changes of the gas on exposure to illumination were measured by both a glass manometer and a platinum resistance thermometer. It was found that no change in the Budde effect could be detected on drying or moistening pure chlorine and bromine. Attempts were made to test the dryness of the chlorine by mixing with hydrogen, in order to see if the mixture was inactive on exposure to light. It appears, however, that dry mixtures cannot be prepared in Pyrex glass, owing to the formation of water by reduction of the glass by hydrogen at the temperature of sealing.

Laminated Glasses.—The *Journal of the Society of Glass Technology*, vol. 13, No. 49, contains an interesting account by W. R. Lyttleton of the history, development, and methods of manufacture of laminated glass, which is rapidly growing in importance for use in the motor industry. Such glass consists of alternately hard and plastic laminæ welded together into one whole, and has the property of not allowing splinters to fly when it is subjected to a violent blow. Generally, either nitro- or acetate-cellulose is employed as the central plastic medium in this type of glass. The surfaces of the glass and celluloid are carefully cleaned, and in some cases the glass is coated with gelatine or cellulose varnish, before they are united by pressure. If gelatine is used as the central sheet instead of celluloid, it must be hermetically sealed between the glass sheets in order that it may retain its moisture content, without which it becomes brittle. The chief difficulties to be faced in the production of these strengthened glasses are discoloration with time and strains set up by unequal expansion of the laminæ.

Critical Temperature Measurements on Carbon Dioxide in Small Capillaries.—As a result of measurements of adsorption of carbon dioxide in silica gel, both above and below the critical temperature, it has been suggested that liquid exists in the pores of the adsorbant above the critical temperature. If this conclusion is correct, then it would appear that some increase in critical temperature should be observed in very fine glass capillaries, even though the diameters of such capillaries are much greater than those of the pores in silica gel. An attempt to determine the effect of capillary diameter on critical temperature is described by H. T. Kennedy in the *Journal of the American Chemical Society* for May. The critical temperature of carefully purified carbon dioxide was measured in capillaries ranging from 2 mm. to 0·004 mm. in diameter and was found to be independent of the size of the tube. The value obtained for the critical temperature, which is defined as the highest temperature at which a sharp meniscus can be seen by transmitted light in the field of a microscope, was $30{\cdot}96° \pm 0{\cdot}01°$. It is suggested that the discrepancies obtained by various workers are due to the different criteria employed to define the critical temperature.

Existence of Free Methyl.—In a recent number of the *Berichte der Deutschen Chemischen Gesellschaft* (**62**, 1335; 1929), Messrs. Paneth and Hofeditz bring forward evidence of the rather transient but definite existence of the simplest hydrocarbon radical, methyl, in the free state. This result was obtained in the course of an investigation of the mechanism of the reaction involved in the production of metallic hydrides by means of a spark discharge, a reaction which appears to necessitate the presence of a hydrocarbon. Carefully purified lead tetramethyl is volatilised in a current of pure hydrogen or nitrogen at a low pressure in a quartz-tube and at a rather low temperature. When the tube is heated with a Bunsen burner, a lead mirror is deposited and an active gas passes on, which is capable of completely volatilising a second deposit of lead previously made in the same way at a point farther from the supply. Lead tetramethyl is apparently reformed, since it in turn can be decomposed in the same way. Moreover, the distance between the mirror which is being deposited and that which is being removed may be so much as 30 cm. and the space may even be cooled, but the effect falls off very rapidly as the distance is increased. Numerous check experiments were carried out in order to show that the volatilisation of the lead is not due to the action either of hydrogen or of any of the following possible by-products: methane, ethane, acetylene, or ethylene; and the authors claim to have proved that the methyl radical is present in the decomposition product of the methide. Preliminary measurements of the rate of volatilisation indicate that the reaction is approximately monomolecular and that the 'half-life period' of the methyl in an atmosphere of hydrogen at 2 mm. pressure is about 0·006 sec. Similar effects have been obtained with bismuth trimethyl, whereas the methides of antimony and zinc both gave disappointing results. Further, it has been shown that both lead and bismuth can be volatilised as methides by the vapours from the decomposition of either lead-tetramethyl or bismuth-trimethyl. It is essential that all materials should be highly purified beforehand.

Strength of Carbon Steels for Boiler Construction.—Special Report No. 14 on Engineering Research issued by the Department of Scientific and Industrial Research (London: H.M. Stationery Office) describes work carried out at the National Physical Laboratory by R. G. Batson and H. J. Tapsell. The object of the work was to provide information regarding the tensile properties and, particularly, the limiting creep stress of low carbon steels for boiler and superheater tubes, and superheater and steam drums. Results of tests carried out at temperatures up to, in some cases, 650° C. on the limiting creep stress in tons per square inch are given for three steels containing respectively 0·10, 0·17, and 0·22 per cent carbon. The last of these materials, which is representative of steel supplied for superheater and steam drums, had a limiting creep stress of 14 tons per sq. in. at 400° C., 9 at 450°, 5·5 at 500°, and 3·5 at 550°. The two lower carbon steels at 500°, 550°, and 600° C. gave creep stress figures of 3·5 and 5·0; 1·2 and 2·2; 0·6 and 1·2 respectively. At 650° C. the 0·17 per cent carbon steel had a creep stress about half a ton per square inch. To prevent oxidation of the specimens, test pieces were coated with a few thousandths of an inch of aluminium by calorising, or with 0·01 inch nickel. It is shown that such protective coatings have no influence on the rate of creep, but provide very good resistance to scaling at the high temperatures. Unprotected samples scaled rapidly above about 570° C., particularly when subjected to excessive straining.

The London School of Hygiene and Tropical Medicine.

THE history of the London School of Hygiene and Tropical Medicine, the new home of which was opened by H.R.H. the Prince of Wales on July 18, goes back to 1921, when a committee appointed by the Minister of Health of that day, Sir Alfred Mond, now Lord Melchett, under the chairmanship of the Earl of Athlone, to report upon the needs of post-graduate medical education in London, advocated among other things the establishment of a central institute of preventive medicine. This recommendation began to bear fruit in the following year, when the Trustees of the Rockefeller Foundation in New York generously offered £460,000 for the building and equipment of such an institute, if the British Government would be responsible for its staffing and maintenance. In the course of their campaign of preventive medicine in all parts of the world, the authorities of the Rockefeller Foundation had arrived independently at the conclusion that a great teaching centre of this nature, with an international outlook, was required if the teachings of hygiene were to be adequately promulgated; and they realised that London, as the capital of the British Empire, the centre of the world's commerce, and the cradle of modern public health administration, would form the ideal site.

Photo.] [*Walshams, Ltd.*

FIG. 1.

Thirty years ago, as is well known, Mr. Joseph Chamberlain, when Colonial Secretary, at the instance of Sir Patrick Manson, founded a school for the study of the diseases of the tropics; and the London School of Tropical Medicine so established, first at the Albert Docks and, since the War, at Endsleigh Gardens, always under the ægis of the Seamen's Hospital Society, has rendered constant service to the Empire. Negotiations with the Seamen's Hospital Society led to the absorption of this school into the new institute; and in August 1924 the resulting "London School of Hygiene and Tropical Medicine", affiliated with the University of London, was incorporated by Royal Charter, a union which serves to emphasise the fact that the fundamental needs of hygiene are the same throughout all climates.

Now that the School is about to take possession of its new premises, it is possible to gauge the magnitude of the task which has been entrusted to the director, Dr. Andrew Balfour. The School consists of six divisions: Public health; epidemiology and vital statistics; bacteriology and immunology; biochemistry (including chemistry as applied to hygiene); medical zoology (including protozoology, helminthology, and entomology); and tropical medicine and hygiene. These divisions will collaborate in providing courses of instruction for the diplomas of hygiene and of tropical medicine and hygiene; independently they will provide advanced teaching in their special subjects; and they will afford ample facilities for research. It has been the constant aim of those concerned with the organisation of the School to secure a nice balance between these several activities, and much of the space available in the building has been so allotted that it may be used for teaching or research as occasion may demand. It

Photo.] [*Walshams, Ltd.*

FIG. 2.

is most desirable that men on furlough from the tropics should have somewhere to go where they can finish off any research work that they may have on hand. The services of the library to the man in the tropics, as well as to the worker in Great Britain, will be no less valuable. For, with the collaboration of the Bureau of Hygiene and Tropical Diseases which will be housed in the building, it is hoped to develop something approaching an international information bureau in all subjects within the purview of the school. The museum also, which will be open to the public, will play an important part, both educational and propagandist. It consists of three parts: sanitary engineering, general hygiene, and tropical medicine. Many of the exhibits have been prepared and presented, and will be kept thoroughly up-to-date by large commercial interests concerned in public health activities of various kinds.

The building which is to subserve this varied array of functions is a massive block in Portland stone lying just north of the British Museum (Fig. 1). The successful design was submitted by Mr. P. Morley Horder, and Mr. Verner O. Rees, in association with Mr. Horder, has carried through the execution of the design so submitted; and despite the economy in external ornament, dictated by the practical needs of the building, the architects have succeeded in making a very pleasing contribution to the architecture of Bloomsbury. The building consists of four main stories with a recessed floor above these, and finally a small top floor composed mainly of animal houses. The walls and foundations have been so constructed that they will support another story should this eventually become necessary.

The general plan of the building is that of a letter H, with the long sides on Gower Street and Malet Street, a cross-bar uniting the two and separating the north and south courts, and with the foot of the H closed by the main front which faces south on to Keppel Street. The severity of the Keppel Street elevation is relieved by a wide frieze composed of wreaths and of the names of some of the pioneers in hygiene and tropical medicine; and a lively series of gilded designs, representing some of the animals which concern the hygienist most closely, are set in the metal balustrades below the first floor windows. These ornaments are continued some way along Gower Street and Malet Street, but beyond this the side elevations are relieved only by the prominent entrances. The main entrance, in Keppel Street, is surmounted by a large panel engraved with the handsome seal of the School.

Probably the most striking feature about the interior of the building is the abundant supply of light and air. The passages are considerably wider than is usually the case in a building of this type, and this reflects the intention of the architects to ensure that the School should in no way fall short of those principles which it will be its main function to inculcate. With the exception of the main lecture theatre, ventilation is secured throughout by natural means; the large open courts help to make this possible. The working departments occupy the sides and cross-bar of the H, and the planning of these departments has varied with their respective functions. The base of the H, the Keppel Street front, contains those sections which are of more immediate concern to the outside public; and in this part, naturally, more concession has been made to architectural effect.

Immediately beyond the entrance hall and occupying the south court is the main lecture theatre. It is the easiest part of the building to find; a most convenient arrangement, for this theatre will frequently be used for 'outside' lectures. On the first floor, the entire frontage is occupied by the library, a wide, imposing room, unbroken by pillars, panelled throughout with oak (Fig. 2). Immediately behind the library, access is provided to the flat roof of the lecture theatre, which will be laid out as a garden court. The second and third floors comprise the museum; the lower devoted to hygiene, the upper to tropical medicine, both splendidly illuminated by large windows in the north and south walls and by three open wells admitting light from above.

The opening ceremony was performed by H.R.H. the Prince of Wales on July 18, almost exactly three years after the foundation stone was laid by Mr. Neville Chamberlain as Minister of Health. The Prince of Wales was received by Lord Melchett, chairman of the Board of Management, who read an address of welcome which outlined the history and functions of the School. In his reply, the Prince of Wales stressed the importance of this great benefaction as a sign of Anglo-American friendship, and expressed his belief that the opening of this School would inaugurate a new era in preventive medicine. When Sir Holburt Waring, chairman of the Court of Governors, had returned thanks to the Prince of Wales for his attendance, and had been supported by Sir Gregory Foster, Vice-Chancellor of the University, His Royal Highness visited the various departments of the building. The assembled company was entertained to luncheon as the guests of Lord Melchett, the building was thrown open for general inspection, and a series of kinematograph displays showing some aspects of preventive medicine were exhibited in the lecture theatre. The School achieved a very gay and successful debut, and, given adequate financial support, there is every reason to expect that it has before it a long and prosperous career "in the Service of Mankind".

History of Science Exhibition at Florence.

THE first National Exhibition of the History of Science is being held from May to October of this year at Florence. It is of great interest to those concerned with the story of the development of scientific thought, although this development is somewhat obscured by the grouping of the exhibits according to their local origin rather than in logical or chronological order.

Of the various sections of the Exhibition, perhaps the most important are those in the rooms illustrating the discoveries of Leonardo da Vinci and Galileo Galilei. Here are interesting models of flying machines constructed in accordance with the descriptions in Leonardo's "Codice del Volo degli Uccelli". Among them is a machine to be fitted to the shoulders, and another of a canvas wing, the formation of which, similar to that of a Venetian blind, was imitated from the wing of a bird. Other designs show Leonardo's final device for the motion of the wings, his "macchina volante con piano portante", representing the final perfection of the type. There is also Leonardo's parachute and his instrument devised for the solution of the problem of the Arabian mathematician, Alhazen.

A number of models illustrate the experiments and discoveries of Galileo. There is the inclined plane for testing the rate of descent of bodies, the semiparabola illustrating the path traversed by objects horizontally projected, and the apparatus that illustrates the action of the pendulum. Here, too, are the 'Compasso di proporzione' or 'military compass',

invented by Galileo in 1596, and a photograph of the first lens constructed by him in 1610, with a diameter of 4 centimetres. There are also various astronomical and other instruments of the sixteenth and seventeenth centuries. Thus we have an apparatus for the discharge of projectiles, with pistol and quadrant attached to it, which belonged in 1597 to Robert Dudley, Duke of Northumberland, and a lens of 1690 used by Averani and Targioni for experiments on the action of solar rays on precious stones, and by Donati for the observation of stellar spectra.

The Exhibition contains many first editions and manuscripts of famous scientific works. Among these are Galileo's "Compasso geometrico" printed at Padua in 1606, the MS. of his first draught of the "Sidereus Nuncius", his "Il saggiatore" (Rome 1623), and his "Delle cose che stanno in su l' acqua" (Florence 1612). There is also Galileo's autograph letter in defence of his "Tractate" on the motion of the earth, from the Biblioteca Roncionana di Prato. Among other early editions of famous works is a copy, printed at Florence in 1611, of Kepler's "Narratio de observatis a se quatuor Iovis satellitibus erronibus".

More modern scientific developments are also represented in the Exhibition. There is a case of manuscripts of Galvani (1737–1798), among which is the holograph copy of his "De viribus electricitatis in motu muscolari". The telescope, microscope, and other instruments used by G. B. Amici are shown, with a copy of the famous electromagnetic machine of Antonio Pacinotti and a case of his manuscripts.

The Turin and Milan rooms are mainly devoted to the development of modern engineering. Here is exhibited the Sommeiller perforator, used in the construction of the Mont Cénis tunnel, the first F.I.A.T. automobile of 1899 and material relating to the making of the first Italian railways. There is a case of autograph letters by Galileo Ferraris, the physicist (1847–97), and the original apparatus constructed by him for the study of the rotating magnetic field. The first instruments used by Marconi, including condenser, receiver, transformer, etc., are to be seen. There is also a case of early printed pamphlets relating to aeronautics, among which is Blancard's "Relation du 15me voyage aérien fait à Francfort A.M. le 3 d'octobre 1785".

It is impossible to close an account of this Exhibition without mentioning the very interesting exhibits of the Reale Academia Nazionale dei Lincei. Among these is a series of manuscript volumes of the proceedings of this famous Italian predecessor of the Royal Society. The first volume is dated 1603, the year of the foundation of the Academy by Prince Federigo Cesi. This case contains also the first editions of some notable works by the early Lincei, including the "De nova stella disputatio" by Johan Eck (Rome 1605), the "De aereis transmutationibus", by Giovanni Battista Porta (Rome 1614) and Galileo's "Il saggiatore" (Rome 1623). In another case are the MS. volumes of the proceedings of the Academia del Cimento, dated 1666 and subsequent years.

The Official Guide and Catalogue to the Exhibition can be obtained on application to the Direzione, Prima Esposizione Nazionale di Storia della Scienza, Piazza Cavour, Firenze. S. D. WINGATE.

Long Delayed Radio Echoes.

PRINCIPAL PEDERSEN, of the Technical College, Copenhagen, has communicated a paper in English on "Wireless Echoes of Long Delay" to the physical section of the Danish Royal Society, which shows that scientific workers hold very different opinions on this subject.

Störmer, Pedersen, and Wagner think that the echoes are caused by radio waves being reflected from swarms of electrons out in space, whilst others, van der Pol, Appleton, and Ardenne, assume that the long delay is due to special conditions in the Heaviside-Kennelly layer. To account for the long delay which sometimes occurs before the arrival of the echo, Ardenne assumes that the waves travel round the earth some hundreds of times. Owing, however, to the necessary attenuation, this assumption presents great difficulties.

Principal Pedersen gives a mathematical proof that the long delayed echoes cannot arise either by the propagation of radio waves within the earth's atmosphere or by the waves travelling outside the latter in a medium so strongly ionised that the group velocity of the electrons approaches zero. In his opinion they are due to the fact that the waves have travelled very great distances outside the earth's atmosphere and have then been reflected by swarms or bands of electrons in space, as described by C. Störmer in NATURE (Vol. 122, p. 681, 1928). The assumption is made that all waves shorter than about 8 metres will penetrate into space with very little attenuation. At noon, all waves longer than about 40 m. are completely reflected or refracted back to the earth. At midnight the waves must be longer than 70 m. to be reflected back. The lengths vary appreciably with the ionisation of the upper atmosphere.

It is concluded by Principal Pedersen that echoes occurring after 10 seconds cannot be due to the propagation of waves within the earth's atmosphere. Echoes occurring after intervals of time up to 30 seconds are probably due to propagation along or reflection from Störmer bands. Occasionally echoes do not occur until several minutes have elapsed. In these cases the bands of ions must be outside the space in which the magnetic field of the earth exerts any appreciable direct influence.

University and Educational Intelligence.

ABERDEEN.—The degree of Doctor of Science has been awarded to Dr. A. N. Campbell, for a thesis entitled "The Existence of Liquid Racemates"; Sophia L. M. Connal (*née* Summers), for a thesis entitled "A Particular Study of 55 Species of Mosquitoes met with in Nigeria"; Mr. G. Redington, for a thesis entitled "The Effect of Light on Plant Growth".

CAMBRIDGE.—The Wrenbury Scholarship has been awarded to L. J. V. Shepherd, of St. John's College. Miss A. S. Dale, of Newnham College, has been re-elected to the Michael Foster Research Studentship in physiology. At Clare College the Denman Baynes Studentship has been divided equally between E. C. Bullard and R. M. Margoei.

EDINBURGH.—The Cameron Prize in practical therapeutics has been awarded to Sir Leonard Rogers, in recognition of the discoveries he has made in the treatment of several tropical diseases, and in particular in the treatment of cholera, amœbic dysentery, and leprosy. This prize is "awarded annually to a person who, in the course of the five years immediately preceding, has made any highly important and valuable addition to practical therapeutics".

LEEDS.—Dr. Ll. Lloyd has been appointed reader in entomology and protozoology.

LONDON.—Prof. H. H. Woollard has been appointed as from Sept. 1 to the University chair of anatomy tenable at St. Bartholomew's Hospital Medical College.

Prof. Woollard was educated at the University of Melbourne and at University College, London. From 1919 until 1923 he was senior demonstrator, and from 1923 until 1927 assistant professor of anatomy at University College, London. Since 1927 he has been professor of anatomy in the University of Adelaide. His publications include "Recent Advances in Anatomy" (Churchill, 1927) and "Scientific Basis of Anatomy" (translated from the German; Bale, Son and Danielsson, 1927).

Mr. L. C. Robbins has been appointed as from Aug. 1 to the University chair of economics tenable at the London School of Economics. Mr. Robbins entered the London School of Economics in 1920 and on graduation was appointed research assistant to Sir William Beveridge, and later lecturer in economics. His published work includes numerous papers on the theory of population, the theory of value, and other problems of economic theory.

The following doctorates have been conferred: D.Sc. in Chemistry on Mr. J. E. G. Harris (University College), for a thesis entitled "The Soledon Reaction"; Mr. A. J. Turner, for a thesis entitled "The Relation between Atmospheric Humidity and the Breaking Strengths and Extensibilities of Textile Fabrics before and after Weathering", and other papers; D.Sc. (Engineering) on Mr. Arthur Winstanley, for a thesis entitled "Roof Control when working Coal Seams by Longwall".

The University Studentship in Physiology for 1929–30, of the value of £100 and tenable for one year in a physiological laboratory of the University or of a school of the University, has been awarded to Miss Margaret Hill.

The Chadwick Trustees have made a grant of £500 towards the cost of equipping the new laboratory of the Department of Municipal Engineering at University College, and also a grant of £200 a year for three years to the Department.

APPLICATIONS are invited by the Association of Surgeons of Great Britain, 17 Wimpole Street, W.1, for a surgical scholarship of the value of £350. The object of the scholarship is to enable the holder to pursue a definite line of research or to study surgery in specified clinics, either at home or abroad, and candidates in their applications should state the line of research or study that they propose to pursue. The latest date for the receipt of applications is Sept. 20.

THE Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships for the session 1929–30 at the centres named: British Fellowship, tenable for two years, to Mr. O. H. Wansborough-Jones (University of Cambridge); British Fellowship, tenable for one year only, to Mr. R. J. Phelps (University of Oxford); Canadian Fellowship to Dr. L. M. Pidgeon (University of Oxford); Japanese Fellowship to Prof. Y. Nagai (University College, London); Spanish Fellowship to Don Andres Leon y Maroto (University College, London); Swedish Fellowship to Mr. E. K. Troell (Rothamsted Experimental Station, Harpenden). The Trustees have renewed the following fellowships for the session 1929–30: Dr. H. Bienfait (Netherland Fellowship at the Imperial College of Science and Technology, London), and Dr. P. Maitland (Glasgow Fellowship at the University of Cambridge). Sir Robert Waley Cohen has been appointed vice-chairman of the Trust in succession to Sir John Brunner, deceased, and the Hon. Henry Mond has been appointed a Trustee.

Calendar of Patent Records.

July 28, 1758.—The production of zinc on a commercial scale was first undertaken by William and John Champion, who erected works at Bristol about 1740. John Champion's patent for extracting zinc from blende, a method of manufacture which did not become general until the middle of the nineteenth century, was granted on July 28, 1758. The Bristol works were later transferred to Swansea, which became the centre of the British trade.

July 30, 1571.—Richard Mathew was the first Englishman to make fine cutlery, an art which he had learnt while travelling abroad. On July 30, 1571, he was granted a patent for the "making of certen haftes called Turkye haftes for knyves, weapons, and other things by hym lately devised in our realme to be made of dyvers peces of horne of one or of sundry coloures mixed and garnished betwene those peces with yellow or white plate", but the patent was successfully contested by the Cutlers' Company before the Privy Council on the ground "that it hath been and will be the overthrow of the cutlers within the city".

July 31, 1781.—One of the early competitors for the prize offered by the Paris Academy of Sciences in 1775 for a practicable process of manufacturing artificial soda was Bryan Higgins, whose invention was patented on July 31, 1781. The process did not overcome the difficulty, but this and other early attempts paved the way for Leblanc's successful solution of the problem a few years later.

July 31, 1846.—Lord Armstrong's invention of the hydraulic crane, which was the pioneer in the application of hydraulic power for lifting purposes, and from which evolved the hydraulic elevator, was patented on July 31, 1846. It was first introduced for lifting the stone in a Yorkshire quarry and was rapidly adopted.

August 2, 1695.—On Aug. 2, 1695, there was granted to Daniel Quare, a noted London clockmaker and the inventor of the repeater watch, a patent for "a portable weather glasse or barometer which may be removed or carried to any place though turned upside down without spilling one drop of the quicksilver or letting any aire into the tube". The Clockmakers' Company took exception to the patent and informed its members that anyone who was proceeded against on account of the patent would be defended, but the quarrel must have been of short duration, for Quare became Warden of the Company in 1705 and Master in 1708.

August 2, 1800.—The rifling-machine for guns dates from the patent of Thomas Gill, gunmaker of Birmingham, whose patent is dated Aug. 2, 1800. The barrel is fixed on a reciprocating frame, and the cutters of the required width are attached to a long bar which passes through the barrel and is rotated in centres at each end by means of a rack and pinion mechanism. No record of a machine having been made is, however, known.

On the same day, Aug. 2, 1800, there was granted to Mathias Koops a patent for his newly invented method of manufacturing paper from straw, etc. The patent was voided by the non-enrolment of a specification, but the process is described in a specification enrolled on a second patent formally granted the following year, though Koops petitioned that a specification might be dispensed with. In 1800, Koops published "An historical account of the substances which have been used to describe events and convey ideas", which was printed on paper made from straw and had an appendix on paper made from wood.

Societies and Academies.

LONDON.

Geological Society, June 26.—**R. O. Roberts**: The geology of the district around Abbey-Cwmhir (Radnorshire). This paper deals with an area of about 30 square miles in north-western Radnorshire. The rocks belong to the Bala, Valentian, and Wenlock Series. Only the lowest beds of the Birkhill Stage are exposed, and they are overstepped by the Tarannon Stage, which, over most of the area, rests directly on folded Bala rocks. The Bala rocks are exposed along the north-eastern extension of the Towy anticline; but, in this district, the anticlinal axis is partly replaced by an important strike-fault, which hades westwards. Subsidiary folds may be recognised within the Bala rocks. The axes of these folds are parallel to the general strike of the strata, although there is a change in the direction of pitch around Nantmel. The Bala rocks were folded in pre-Tarannon times, but broad shallow folds in the Tarannon and Wenlock rocks indicate that there has been a repetition of folding along the same lines at different periods.—**C. A. Matley** and **A. Heard**: The geology of the country around Bodfean (south-western Carnarvonshire). The area includes the prominent hill of Garn Bodfean (918 feet above O.D.) and a lesser hill, Moel y Penmaen. Most of the remaining ground is covered by drift. The country can be divided into two belts with reference to the dominant east-north-easterly strike. In the southern belt there is a volcanic series of submarine lavas and tuffs interbedded with ashy and argillaceous sediments. Fossils found at several horizons indicate a Lower Bala age. Garn Bodfean, in the northern belt, consists of a great mass of 'felted' and granular keratophyres and some quartz-keratophyres. It seems possible that the whole hill is a transported mass carried over the Nevin Shales by earth-movements. All the igneous rocks of the area are considered to be extrusive, with the possible exception of a basalt, which may be a sill. A detailed account of the petrography and tectonics of the area is given.—**G. H. Mitchell**: The petrography of the Borrowdale volcanic series of the Kentmere Area (Westmorland). The volcanic rocks are composed of both lava-flows and tuffs of intermediate composition, varying from basic andesites to rhyolites. The rocks are greatly altered, and this has led to difficulty in distinguishing between lava-flows and tuff-deposits, particularly when the former are brecciated owing to flow. The alteration of the rocks, as shown by the changes in mineral composition, together with the materials filling the vesicles, is considered. Much of the alteration may be referred to a variety of propylitisation.

PARIS.

Academy of Sciences, June 17.—The president announced the deaths of Henri Andoyer, Charles Moureu, and Léon Lindet.—**Charles Moureu, Charles Dufraisse, and Joseph Robin**: Researches on rubrene. Study of the mechanism of its formation: description of an intermediate chlorine derivative. In the preparation of rubrene an intermediate compound of the composition $C_{42}H_{29}Cl$ has been obtained by modifying the conditions of the reaction; that this is really an intermediate stage in the formation of rubrene is shown by the fact that it is readily transformed into rubrene without by-products.—**P. A. Dangeard** and **Mme. Mara Lechtova Trnka**: The phenomena of symbiosis in *Myrica Gale*. The tubercles frequently found on this plant are due to a bacterium, for which the name *Rhizobacterium Myricæ* is proposed. Its relations with the cells of the *Myrica* closely resemble those in the tubercles of the Leguminosæ.—**de Possel**: The characteristic invariants of varieties in two dimensions with infinite connexion and the homeomorphy of discontinuous closed ensembles.—**J. Delsarte**: The group of conformal geometry in space of functions of summable square.—**G. Kolossoff**: The extension of a theorem of Maurice Lévy.—**A. Martinot-Lagarde**: An arrangement of an aerodynamic tunnel for the study of flow in two dimensions.—**I. Tamm**: The new theory of A. Einstein and the theory of quanta.—**G. Bruhat**: The notations of thermodynamics.—**E. Sevin**: The introduction of an electric charge vector. Application to the synthesis of the theories of electromagnetism, of light, and of gravitation.—**Pierre Daure**: The photometric study of the Raman effect.—**J. Gilles**: The ultra-violet bands of sulphur.—**Trajàn D. Gheorghiu**: A method of photoelectric photometry with a variable source of radiation. The method described avoids the necessity of using two exactly similar photoelectric cells or absorbent standards, and an ordinary Heraëus mercury lamp can be used as the source of light.—**M. Mathieu**: Crystal constants of the compound $K_2(PtBr_6)$.—**E. Larroque**: The discovery of a Strombus horizon in the island of Djerba (Tunis).—**A. Demay**: The general structure of the Hercynian subdivision.—**Louis Dangeard**: The Bacteriaceæ of the Oolitic iron minerals. The facts observed, while not excluding the possibility of chemical action, confirm the hypothesis that the ferruginous bacteria play an important part in the formation of these iron minerals.—**P. Choux**: The Dideraceæ, Madagascan xerophytes.—**A. Guilliermond**: The development of a *Saprolegnia* in media containing vital colouring matters and the coloration of the vacuome during growth. A comparison of various colouring matters showed that neutral red is very slightly toxic for *Saprolegnia*: this develops nearly normally in the presence of small quantities of this dye which it accumulates in its vacuome.—**E. Chemin**: The variations of iodine in *Trailliella intricata*.—**Jules Amar**: The origin and destination of the cellular fats.—**Paul Dutoit** and **Christian Zbinden**: The spectrographic analysis of the ashes of the blood and of organs. Arc spectra from the ashes of the blood indicate the presence of thirteen elements, including silver, copper, manganese, titanium, and zinc. Examination of the ashes of various organs show a selective action of the pancreas on nickel, cobalt, and lead. The suprarenal capsules appear to retain tin, while zinc is abundant in the liver and kidney. Copper and silver disappear in tumours.—**L. Margaillan**: The regularity of the variations of the characters of oils extracted from a given animal as a function of the point of withdrawal. The fats extracted from tissues taken from various points of *Delphinus tursio* show marked differences in composition. These variations are not irregular, the iodine absorption figure, for example, increasing from the nose to the tail.—**R. Fosse, A. Brunel**, and **P. de Graeve**: The application to urine of the biochemical determination of allantoin.—**E. Doumer**: Osmotic drainage.

CAPE TOWN.

Royal Society of South Africa, May 15.—**A. L. du Toit**: The volcanic belt of the Lebombo—a region of tension. The belt of the Lebombo follows the thirty-second meridian for six degrees and is composed of Karroo Beds disposed in the form of a monocline sinking eastwards beneath the Cretaceous and younger deposits of the littoral. The volcanic rocks of which it is mainly composed consist of a lower group of basalts (and in the north of limburgites and alkaline basalts), a middle one of rhyolites and an upper one of basalts, to a maximum thickness of about 9000

metres. Originating out of crustal tension is a swarm of dolerite dykes, and in the lower group of dykes of felsite and larger linear bodies of dolerite, gabbro and granophyre with north-south trend, regarded as the consolidated feeders of the lavas. Judging from the tilting of these dykes, the growth of the monocline took place during the middle of the eruptive period, seemingly during the Liassic. The crest of the range marks a surface of planation developed during the late Mesozoic and early Cainozoic.

LENINGRAD.

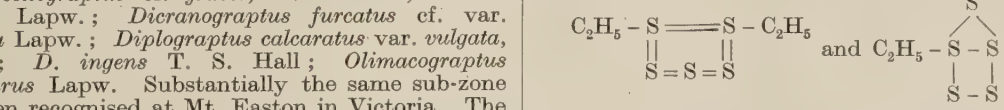
Academy of Sciences (*Comptes rendus*, No. 5).—**P. P. Lazarev and S. Lioznianskaia**: The structure of annealed glass. A description of physical properties including the polarisation phenomena.—**V. I. Vlodavec**: Results of the investigations on the apatite deposits in the Khibin tundras in 1928. The deposits are characterised by the presence of rare earth, particularly of strontium, as well as of phosphorus, fluorine and titanium. Preliminary estimations of phosphorus show that its quantity must be sufficient for an extensive development of a superphosphate industry.—**E. F. Miram**: Contributions to the knowledge of Palæarctic Orthoptera. Descriptions of *Pœcilimon bifenestratus*, sp. n. from W. Caucasus and *Paradrymadusa kiritshenkoi*, sp. n. from Mongolia; the latter species belongs to a genus hitherto known only from Mediterranean countries.—**N. Annenkova**: A new polychæte worm, *Oridia rivularis*, sp. n. from brackish water in the Shantar Islands, in the Okhotsk Sea. Four other known species of the genus occur on sea-shores.—**N. Annenkova**: Corrections and additions to the fauna of Ponto-Caspian Polychæta. Notes on distribution and morphology of a number of species.—**G. Y. Vereščagin and I. P. Sidorytchev**: Some observations on the biology of Comephoridæ. *Comephorus dybovskii* Kor. and *C. baicalensis* Pal., two endemic fishes of Lake Baikal, are not typical deep-water fishes as was supposed previously. The reproductive seasons differ, that of *C. dybovskii* being in February–March, and of *C. baicalensis* in July–August. The food of *Comephorus* was found to consist of an endemic gammarid crustacean, *Macrochetopus branickii* Dyb.

MELBOURNE.

Royal Society, May 9.—**W. J. Harris and R. A. Keble**: A collection of graptolites from the Federal Territory. This is the first collection of graptolites from the Federal Territory. The forms recognised are *Dicellograptus* cf. *gravis*, K. and H.; *D.* cf. *gurleyi* Lapw.; *Dicranograptus furcatus* cf. var. *minima* Lapw.; *Diplograptus calcaratus* var. *vulgata*, Lapw.; *D. ingens* T. S. Hall; *Olimacograptus tubuliferus* Lapw. Substantially the same sub-zone has been recognised at Mt. Easton in Victoria. The British equivalent is the *Dicranograptus clingani*, sub-zone 12, in Elles and Wood's Zonal Distribution (Pal. Soc.).

ROME.

Royal National Academy of the Lincei, May 5.—**U. Cisotti**: Christoffel's second triple tensor and the intrinsic derivation.—**G. A. Maggi**: The potential function of a double layer. (Extract from a letter to T. Levi-Civita.)—**S. Pincherle**: Linear functional operations and developments of the zero.—**A. Bemporad and L. Genovese**: Investigations on the systematic errors of the Draper Catalogue. The errors in this catalogue which can be investigated according to (1) the spectral type and (2) the stellar magnitude are considered, and a table is given for the simultaneous correction of the two errors. Further calculations are being made for a more general treatment of the question, which is of fundamental interest for the photometric reduction of the twenty zones into which the Astrographic Catalogue is subdivided.—**M. La Rosa**: The interpretation of the behaviour of Algol, and the variability of the velocity of light. A further point remaining obscure in the author's ballistic theory of variable stars is examined, namely, the divergence between the theoretical predictions and the behaviour exhibited by Algol and analogous stars, this divergence having been pointed out by Bernheimer and by Salet and used by them as the basis of their denial of the applicability of the ballistic principle to the propagation of light. It is shown that the phenomena presented by such stars actually furnish a striking confirmation of the author's theory.—**U. Bordoni**: Measurement of the thermal conductivity of specimens of irregular shape.—**G. Rovereto**: The tectonic indications of a new railway tunnel of the Ligurian coast.—**L. Petri**: Alterations produced in the stem of papyrus by protozoa. Papyrus growing in Syracuse is subject to various parasitic diseases; one of these, which causes rotting of the portion of the stem immersed in the water, being caused by a flagellated protozoon. The nutriment of this organism consists of the protoplasm and starch granules of the peripheral parenchymatous cells, which it invades by perforating the pecto-cellulosic wall.—**S. Minetti**: Ratio of convergence of Taylorian development.—**S. Cherubino**: Definite or semi-definite polynomes.—**A. Tonolo**: Classification of the surfaces of Hilbertian space, the 2-tangent space of which is of four dimensions (2).—**G. Bacchi**: Decomposition of vectorial hyperhomographs.—**A. M. Bedarida**: The prime ideals of a quadratic body.—**L. Onofri**: The series of powers which assume the circumference of convergence as a singular line.—**L. S. Da Rios**: Curved tubing and wings.—**E. Gugino**: Extension of the theorem of maximum kineto-dynamic effect to the motion of systems with unilateral linkings.—**G. Viola**: Light curve and period of W Ursae majoris.—**U. Barbieri**: Radiotelegraphic determination of longitude, and local attraction in the first order peak Monte Colma di Mombarone.—**R. Brunetti**: Theory of paramagnetism for ions subject to intense molecular action.—**Marya Kahanowicz**: A new series in the spectrum of iron, produced by highly condensed discharges.—**S. L. Straneo**: The functional resolution of the linear problems of the propagation of heat.—**G. R. Levi and A. Baroni**: Diethyl pentasulphides. Two isomeric diethyl pentasulphides are obtainable, their constitutions being probably represented by the formulæ:



The former is probably the isomeride boiling at 119° under 26 mm. pressure and formed by the condensation of sulphur trichloride with mercaptan, and the latter the one having the boiling point 130° and produced by the direct action of sulphur on ethyl disulphide.—**E. Pace**: Condensation of piperonaldehyde with certain pinacolines. The condensation products of piperonaldehyde with the three pinacolines, methyl tert. butyl ketone, ethyl tert. amyl ketone, and propyl tert. hexyl ketone, are described.—**A. Ferrari, A. Celeri, and F. Giorgi**: The importance of crystalline form in the formation of solid solutions (5). Thermal and X-ray analyses of the anhydrous systems, $CoCl_2 - FeCl_2$ and $MnCl_2 - FeCl_2$. The melting points of these anhydrous chlorides, based on those of sodium and potassium chlorides as 803° and 774° respectively, are $722° \pm 1°$ for cobalt chloride, $674° \pm 1°$ for ferrous chloride, and $650° \pm 1°$ for manganous chloride. Ferrous chloride is miscible in all proportions with

each of the other chlorides, and the melting points of the mixtures are intermediate to those of the components, the intervals of crystallisation being so small as to be inappreciable. For the $CoCl_2 - FeCl_2$ mixtures, the angle of the rhombohedron remains unchanged at 60° and the magnitude of the side a varies from 7·05 A. for $CoCl_2$ to 7·155 A. for $FeCl_2$. With the $FeCl_2 - MnCl_2$ mixtures, the angle of the rhombohedron varies from 60° to 61° 25′, the value of a from 7·155 to 7·20, and the ratio $c : a$ from 2·45 to 2·37 in passing from $FeCl_2$ to $MnCl_2$.—**T. G. Levi**: A new class of organic sulphur bases. When an alcoholic solution of aniline is added to a 20 per cent aqueous alcoholic formaldehyde solution into which hydrogen sulphide has previously been passed, heat is generated and 3 : 5-diphenyl – 1 : 3 : 5-dihydrothiazine is formed. Other aromatic amines form similar compounds, and analogous selenium derivatives are obtainable if hydrogen selenide is used in place of hydrogen sulphide.—**Aldo Spirito**: Observations on the regulative processes in relation to the development of the cerebral hemispheres in embryos of Anura (2).—**C. Forti**: Further investigations on the action of certain alkaloids on leucocytes isolated from the organism. Before causing the death of the cell, the hydrochlorides of cocaine, novocaine, and tutocaine give rise to an arrest of its activity, that is, to a suspension of the cellular functions from which recovery is possible. The ease with which these compounds are eliminated or destroyed by the cellular protoplasm varies in degree with the different alkaloids.—**U. Cassinis** and **L. Bracaloni**: Normal alcoholemia during physical exercise. Experiments on eight individuals fail to furnish evidence that alcohol, even in minimal amount, is formed in the blood as a result of muscular work.—**A. Galamini**: The food value of legumes studied with albino rats. When rats are fed solely on raw beans, their urine becomes first neutral and then alkaline, the animals losing weight and dying more rapidly than when fasting. If the beans are cooked, the rats withstand the diet far better, although they lose in weight.—**S. Goldberger**: The action of pH on striated muscle. Experiments made on the lines of Trendelenburg's perfusion method with frog's muscle show that variation in the pH of the liquid (Ringer's) is not accompanied by modification of the latent time. With change of the pH from 5·8 to 9·0, the threshold value, the optimum stimulus, and the magnitude of the muscle contraction alter very little, any slight variations being only gradual. If the pH of the liquid is below 5·8 or above 9·0, the threshold value changes slightly in the first, and diminishes considerably in the second, half-hour, the degree of the diminution being greater in the alkaline than in the acid liquid. As regards the pH in the liquid after the perfusion, with initial pH values between 3·2 and 10·8, the muscle exhibits perfect equilibrating power, the Ringer's liquid having the pH 6·7 after perfusion, even when the experiment is continued for twenty-four hours. With higher or lower pH values, the liquid remains the same after as before the perfusion.—**R. Margaria**: The alkaline reserve of sea-water. Experiments on the capacity of sea-water to fix carbon dioxide indicate that, although the reaction of the water is markedly alkaline, this is displaced, in the perfusion of surviving organs, towards the acid side solely by the presence of the carbon dioxide produced by the tissues and that, considering the pressure of the dioxide existing in the tissues, such displacement might be sufficient to make the pH value less than that of organic liquids. It cannot, however, be assumed that this phenomenon would actually occur, since the tissues have sufficient regulating power to enable them to confer their characteristic reaction on the perfusion liquids.

Official Publications Received.

BRITISH.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 12: The Cattle Tick Pest and Methods for its Eradication. Pp. 23. (Melbourne: H. J. Green.)

Indian Journal of Physics, Vol. 3, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 12, Part 4. Conducted by Sir C. V. Raman. Pp. 451-536+plates 22-24. (Calcutta.) 3 rupees; 4s.

Flora of the Upper Gangetic Plain, and of the Adjacent Siwalik and Sub-Himalayan Tracts. Vol. 3, Part 3: Palmæ to Cyperaceæ. Pp. ii+285-371. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1s. 3d.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 13: Technological Report on Samples of Punjab-American and Mollisoni (desi) Cottons grown in different Parts of the Punjab in the Season 1928-29. By A. James Turner. Pp. 10. (Bombay.) 6 annas.

Astrographic Catalogue 1900·0. Sydney Section, Dec. −51° to −65°, from Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 5: R.A. 0^h to 6^h, Dec. −52° to −54°, Plate Centres Dec. −53°. By J. Nangle. Pp. ii+25. Vol. 6: R.A. 6^h to 12^h, Dec −52° to −54°, Plate Centres Dec. −53°. By J. Nangle. Pp. ii+92. (Sydney: Alfred James Kent.)

County Borough of Halifax. Third Annual Report of the Corporation Museums for the Year 1927-8. Pp. 18. (Halifax.)

FOREIGN.

Proceedings of the United States National Museum. Vol. 76, Art. 3: Descriptions of New Species of Foraminifera of the Genus Discocyclina from the Eocene of Mexico. By Thomas Wayland Vaughan. (No. 2800.) Pp. 18+7 plates. Vol. 75, Art. 12: A New Liver Fluke from a Monkey and New Parasitic Roundworms from various African Animals. By J. H. Sandground. (No. 2783.) Pp. 11+2 plates. Vol. 75, Art. 13: Bugs of the Family Miridae of the District of Columbia and Vicinity. By H. H. Knight and W. L. McAtee. (No. 2784.) Pp. 27. Vol. 75, Art. 21: A New Species of Trematode Worms belonging to the Genus Hasstilesia from Rabbits in Texas. By Asa C. Chandler. (No. 2792.) Pp. 5. Vol. 75, Art. 23: A New Species of Mosquito from Montana with Annotated List of the Species known from the State. By Harrison G. Dyar. Pp. 8. (No. 2794.) Vol. 76, Art. 2: A Revision of the Two-winged Flies of the Genus Procecidochares in North America with an Allied New Genus. By J. M. Aldrich. (No. 2799.) Pp. 13. Vol. 75, Art. 26: Two New Species of Polychaetous Annelids from the Argentine Coast. By A. L. Treadwell. (No. 2797.) Pp. 5. Vol. 75, Art. 20: Tapeworms of the Genera Rhabdometra and Paraiterina found in the Quail and Yellow-billed Cuckoo. By Myrna F. Jones. (No. 2791.) Pp. 8+1 plate. Vol. 75, Art. 22: Pagecrinus, a New Crinoid Genus from the American Devonian. By Edwin Kirk. (No. 2793.) Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Bulletin of Development covering the Thirty Months ending December 31st, 1928. Pp. 67. (London: Adam Hilger, Ltd.)

Apparatus for Radiology: High Tension Transformer Units. (Publication No. A/29.) Pp. 16. (London: Newton and Wright, Ltd.)

Heat Treatment Bulletin. No. 42: The Heat Treatment of High Tensile Aluminium Alloys. By A. R. Page. Pp. 8. (London: Wild-Barfield Electric Furnaces, Ltd.)

Diary of Societies.

PUBLIC LECTURE.

FRIDAY, JULY 26.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (Annual General Meeting) (at Royal Society of Arts), at 5.30.—Sir Oliver Lodge: Beyond Physics.

CONGRESSES.

JULY 26 AND 27.

WOMEN'S ENGINEERING SOCIETY (Annual Conference of Women Engineers) (at Bedford College for Women).

Friday, July 26, at 8.—Lady Moir: Presidential Address.

Saturday, July 27, at 2.30.—Miss D. D. Buchanan: Some Modern Bridges: A Brief Description of their Construction (Lantern Lecture).

AUGUST 4 TO 9.

GENEVA INSTITUTE OF INTERNATIONAL RELATIONS.

Monday, Aug. 5, at 10 A.M.—K. Zilliacus: The Structure and Working of the League of Nations.

At 8.30.—E. J. Phelan: The Future of the International Labour Organisation.

Tuesday, Aug. 6, at 10 A.M.—Norman Angell: The Economic Causes of War.

At 8.30.—Henri Rolin: The Peaceful Settlement of all Disputes.

Wednesday, Aug. 7, at 10 A.M.—Prof. J. L. Brierly: The Contribution of Law to Peace.

At 5.30.—H. S. Grimshaw: The Problems of Native Labour.

At 8.30.—The Unreadiness of Public Opinion.

Thursday, Aug. 8, at 10 A.M.—Arnold Forster: The Freedom of the Seas and the Outlawry of War.

At 8.—W. T. Layton: Reparations and Debts.

At 5.30.—G. A. Johnston: Industrial Relations.

Friday, Aug. 9, at 10 A.M.—A. E. Zimmern: The Preparation of Public Opinion.

At 3.—Prof. S. de Madariaga: The Monroe Doctrine and the League of Nations.

At 5.30.—Prof. C. K. Webster: The Far East.

Public Library

NATURE

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Coal, Iron, and World Peace.

THE subject of Sir Thomas Holland's brilliant and epigrammatic presidential address to the British Association Meeting at Johannesburg, which is printed in the Supplement to this issue of NATURE, is appropriate to the great and varied mineral wealth of South Africa. The address is not an account of the advance of science in the investigation of minerals or of the present stage of scientific opinion as to their genesis ; it deals with their political applications. Its aim is stated in the closing sentences : "Next year the Empire Congress of Mining and Metallurgy will meet in this city to discuss the proposition which I submitted to it at Montreal in 1927 ; and this address must be regarded, therefore, as an introduction to a movement which one hopes will supply the necessary data, and so facilitate a working agreement between the two great mineral powers that alone have the avowed desire and the ability to ensure the peace of the world."

Coal and iron ore are the dominant minerals, as their products are necessary both in industry and war, and their exceptional abundance on the opposite sides of the North Atlantic has, according to Sir Thomas Holland, established the existing political supremacy of the United States and north-western Europe. The distribution of these minerals he considers so remarkable that he suggests its use as a further argument in favour of Wegener's hypothesis of continental drift. His main thesis is that America and the British Empire, owing to their control of coal and iron ore, can, if they will, stop war by refusing to supply the products of those minerals to any belligerent power. He claims that the only two nations that could fight for long on their own resources are the British Empire and the United States, and if they refuse mineral products to countries that infringe the Kellogg Pact, no war could last long.

This view agrees with Mr. Foster Bain's classification of minerals into three groups—those sold by the ton, such as coal and iron, the lack of which, he remarks, would put any country "under bonds to keep the peace" ; pound-minerals, such as copper and lead, which can be stored in sufficient quantity to last through an ordinary war ; and ounce-minerals, such as gold and platinum, which can be smuggled during war into any country which has sufficient credit to purchase them. Mr. Foster Bain holds that no nation could maintain a long war under modern conditions without native supplies of iron.

The power of the United States and the British Empire to stop war by refusing iron to the combatants would, however, be restricted by the enormous quantities held by all developed countries. The need for food might prevent a blockaded country beating its ploughshares into swords, but it could probably obtain enough iron for military purposes by turning its scrap into swords and its rails and railings into gun barrels and armour plate. The largest supplies of European coal are in Germany and Silesia, and most countries have unlimited quantities of material which could be used as iron ore if required in war, though it could not be profitably smelted at peace-time prices.

Sir Thomas Holland recognises that some instrument is necessary to enforce the recent treaties against war; and he believes that it could be found on the lines of the resolution submitted to the American Senate last February by Senator Capper, who proposed that the United States should refuse munitions to any nation that breaks the treaty for the renunciation of war. Sir Thomas Holland applauds that resolution, but proposes to modify its terms by substituting 'mineral products' for 'munitions'.

Sir Thomas Holland's second main proposition is that the political dominance of the North Atlantic countries is assured by the poverty in iron ore and coal of the lands west of the Pacific. The belief that the bulk of the world's supplies of coal and iron are beside the North Atlantic has been repeatedly expressed in America in recent years. This conclusion was advanced by Dr. C. K. Leith in 1925, and published in "Foreign Affairs" (New York, 1926), and it has been supported, after an elaborate inquiry, by Foster Bain and other American experts. According to Leith and Foster Bain, the notion that China is one of the richest countries in the world in coal and iron is fiction based on the reports by von Richthofen. Later estimates have reduced the supposed quantities of Chinese coal and ironstone. American authors have also thrown doubt on the reported numbers of the Chinese people and denied China's claim to have the largest population in the world. But the older figures have been supported by later evidence; and the same may happen regarding Chinese mineral resources.

The amount of coal and iron in China at present is utterly uncertain. The figures that were first put forward to replace von Richthofen's general statements were huge. Drake's estimate of the coal reserves of China was nearly 1,000,000 million tons; Inouye of Japan reduced the amount to 40,000 million tons. Dr. V. K. Ting, however, supports Drake's total as being "certainly of the right order of magnitude". The amount has been reduced to 23,000 million tons in the cautious calculations of the present Director of the Geological Survey of China, Dr. W. H. Wong, who naturally declines to include material in his returns without definite evidence. Further investigations may lead to the expansion of his figures, just as the British coal reserves have steadily grown, in spite of the heavy coal consumption, by the inclusion of previously unknown or incalculable reserves.

Some of the older statements as to the unlimited mineral wealth of China may have been due to Oriental exaggeration, and some recent estimates have been under-statements due to Western caution. The amount of coal in China is unquestionably enormous, and the western Pacific has far larger reserves of good iron ore than was recognised by some American estimates. Mr. Foster Bain, in a recent article, remarks that the supply of iron ores in Malaya and the East Indies is "truly great, running into hundreds of millions of tons". It is true as regards China that Tegengren in his memoir on the Chinese iron ores (1923–4) estimates the known or probable reserves as only 950 million tons; that amount is not so large as it looks, as the United States uses about 60 million tons a year. Nine-tenths of Tegengren's estimate consist of the ancient ores of Chihli and Fengtien; the remaining tenth includes 83 million tons of contact ores, which in most continents form a small proportion of the supply, and 5 million tons of other ore. There are in other parts of China large supplies of iron ore which were not included, as neither the quality nor quantity is known. The estimates of the iron ore supplies of China are as unreliable as those of Africa by Rösler (1921), who credited Africa with only one-sixth of the quantity known in Europe. That figure indicated lack of information rather than lack of African iron ore.

Sir Thomas Holland is no doubt correct in his conclusion that the Western Pacific will not disturb the political supremacy of the North Atlantic within any time of practical moment; but the predominance of the western world probably depends more on psychological factors than on the supplies of coal and iron ore. Sir Thomas Holland's address will arouse widespread interest, for it is illuminated by his gift of graphic phraseology, and its discussion will prepare for the consideration of this important problem at the Johannesburg meeting next summer of the Empire Mining and Metallurgical Congress.

Bateson and Mendelism.

Scientific Papers of William Bateson. Edited by R. C. Punnett. Vol. 1. Pp. viii + 452 + 7 plates. Vol. 2. Pp. viii + 503 + 29 plates. (Cambridge: At the University Press, 1928.) 42*s.* net each.

ACCORDING to a statement in his biography, recently published, Bateson intended at some time to write the history of Mendelism. Interesting as such a review would have been, the result has, in effect, been accomplished by the publication of his scientific papers and public addresses; for we have here not only a record of English work covering the early days of Mendelism, but also a general summary of much of the work done elsewhere. These papers, taken in conjunction with Bateson's biography, tell nearly the whole story of the fateful years following the rediscovery of Mendel's work in 1900. Possibly, in retrospect, emphasis might now be differently placed, and much of the detail relegated to the background, but the vividness of the recital by those in the midst of the enthusiasm of verifying and expanding Mendel's work might be lost in a strictly historical review.

When the history of Mendelism comes to be written, there can be little doubt but that Bateson's insistence on the importance of Mendel's work will receive its just appreciation. Both in Great Britain and in the United States, he did much to direct the attention of the younger generation to the new discovery. Even Bateson's controversies went far towards overcoming the inertia and scepticism of those who had adopted an attitude towards the study of heredity that was inimical to Mendel's clear-cut exposition. While Bateson's advocacy speeded up the study of heredity along Mendelian lines, we of the English-speaking race should not forget that the real discovery of the significance of Mendel's work came from Holland, Germany, and Austria, and that the discovery was not so much due to a literary find as to confirmation of Mendel's laws from data almost identical with his. It is, of course, a moot point whether, even then, these data would have received the scientific interpretation which Mendel furnished, had not the later work led to the recovery of his paper before the newer results were interpreted. The inside story of the finding of Mendel's paper has, I believe, never been told in print, which is a pity, since it is an extraordinary circumstance that three investigators should have simultaneously found a paper that had been completely forgotten for thirty-five years.

Bateson's study of discontinuous variability during the decade preceding 1900 had led him to the conviction that this sort of variability provides the most fruitful material for the study of evolution. In this connexion it is not uninteresting to follow Bateson's procedure in trying to find a solution of the kind of discontinuity present in serial homology and kindred morphological series. It is clear from his vague comparisons with ripple marks, etc., that he had not himself at that time (1890) become free from the kind of speculation familiar to the old morphology, despite his attacks on the methods in general of that school.

Comparing Bateson's paper read before the Royal Horticultural Society in 1899, when Mendel's work was unknown to him, with one read before the same Society in 1900, when he had de Vries's paper before him, it is apparent that while at the earlier date the importance of discontinuous variation, the study of single characters and of their inheritance, is emphasised, the underlying principles are not suggested. It is well to remember, however, that it took Mendel himself nearly ten years before he had in hand the experimental proof that established his laws.

The immediate extension of Mendel's principles we owe in part to Bateson and Punnett and the Cambridge School, but equally I think to Cuénot's series of brief but convincing contributions (1902–3), that not only established the application of the same principle to animals, but also furnished interpretations of several new principles. These came at a critical moment and served to widen the field of work. Bateson's interpretation of his own experiments on animals furnished equally important evidence of the extension of Mendelian principles to the animal kingdom.

It is to be regretted, I think, that the materials in the Reports to the Evolution Committee from the Cambridge School are not included in these two volumes (the summaries are, however, included), even had it been necessary to omit some of the other papers to make way for these. To the student of genetics the data given in these reports will be looked upon as the most outstanding contribution to genetics made during the earlier years of Mendelism.

A survey of Bateson's later work, after he had taken charge of the John Innes Horticultural Institution, cannot be attempted in a brief review. It expanded, and kept on expanding. Many of the new problems that arose were still unsolved at the time of his death, but the results of his inspiration and enthusiasm still continue. Sometimes I have thought that his delight in new adventures

distracted his attention from digging deep into the underlying principle of work already under way; yet, on the other hand, he pursued the evanescent 'rogues' to the very end, and 'sports' from root cuttings and 'chimæras' remained abiding problems.

Meanwhile work on the chromosome basis of heredity was coming more and more to the front, and its value in certain lines of research was everywhere becoming apparent. Bateson tried hard to give its proper due to this field of research, but it was only too apparent that it was distasteful to him and that he was, as he himself acknowledged, unfamiliar with first-hand information on cytology. He yielded for a moment after his last visit to America, but recanted, in part, in one of his latest papers. This has always been a source of regret to those of his friends 'over here' who had and have a high regard for his splendid abilities. An appreciation of the evidence and a little sympathy for these new lines of attack that were yielding promising results might, we thought, have simplified some of his perplexities.

From an early period Bateson's interest turned toward the study of variability in relation to species formation; and despite his sincere appreciation of the new openings presented by Mendel's discovery, he never succeeded in adjusting the results of the newer work on mutation and heredity to the historical problem of the evolution of species. He refused to minimise the importance of the older aspects of the problem, as many others have done, in the belief that after all they present a difficulty to those who insist on arbitrary definitions of species. Tradition had a powerful grasp on Bateson's mind, and he could not free himself from the supposed importance of some of the old difficulties connected with the origin of species. Systematists still follow their necessary methods of description, paying scant attention to genetic work; while geneticists are directing their main efforts towards solving other problems than the traditional problem of the infertility between species. Bateson stood firm in his contention that the outstanding question of genetics remains the species question.

The publication of these collected papers not only serves to perpetuate an important period in British biology, but also has made more accessible to students contributions that have been scattered in many journals, some of them difficult to obtain. The publisher and editor are to be congratulated on the accomplishment of a splendid memorial to an indomitable leader in the field of genetics.

T. H. MORGAN.

A Seventeenth Century Water-Bailiff's Duties and Rights.

A Description of the High Stream of Arundel, the Heads and Risings thereof; the Sundry Kinds of Fishes therein in their several Haunts; the Fishermen, and their Care and Service in preserving the Fish in Roading Time; the Swans and Eyries, and other Fowl in their several Limits; the Water Bailiff of the aforesaid High Stream in Arundel Rape, his Fees, Dues, and Duties. Edited, with Introduction, Notes, Map, and Index, by Joseph Fowler. (Extra Publication, No. 1.) Pp. 71. (Littlehampton: Nature and Archæology Circle, The Museum, 1929.) 7*s.* 6*d.*

IN this book we have a vast amount of antiquarian material that is of considerable local interest, and in so far as it touches on the rights and duties of a water-bailiff in mid-seventeenth century times, it will be of value to many whose interests lie beyond the bounds of West Sussex. Herein is printed in full a manuscript of which the first part is known only by two copies, which were made in 1899 for the Duke of Norfolk when defending his fishing rights, and the second part of which has been copied directly from the original. This was discovered after considerable search at Old Norfolk House, tied up with other manuscripts relating to wrecks upon the Sussex coast. The manuscript was known to Caraccieli (1766), Dallaway (1819), and Tierney (1834), but the first part of the original is still missing.

The river that we now know as the Arun is said to have been known of old as the High Stream in Arundell Rape, and in "middle times" as Alta Ripa; but by the Norman-English as Hault Rey. The water-bailiff who compiled the manuscript was one of considerable learning. He lived at Stopham, and his identity can only be conjectured, but the interesting suggestion is made that he may have been one of the Barttelott family. Apart from the fact that from the ancient style in which it is written, it is not always easy to understand what is exactly meant; it is replete with references to old customs, rights, and observances, and these are made increasingly valuable by the footnotes which have been made by the editor, which show a great amount of learning and research.

The natives of the county were called by the Saxons the Homelings, whilst those who came to dwell among them came to be known as the Comelings. With the modern popularity of Sussex, we fancy the Comelings are more in evidence than ever they were before. The author is sometimes severe

on the antiquarians who write without full knowledge or inquiry into the subject of their writings, and it must be admitted that if writers in other parts of the country could have access to documents such as that which has been printed, even supposing them to be in existence, antiquarian knowledge would be greatly increased.

In tracing the course of what we call the Arun from its sources, the author mentions the various streams and rivulets which feed the river, and gives concise information as to the bridges, and does not fail to say who should repair them and who has failed in this duty. An interesting tradition is mentioned that the river entered the sea in former times near Lancing, " where Bramber River (Adur) then likewise vented itself ". This is a subject that deserves further inquiry, for it is not inherently improbable. Such a course would take the river to the rear of Littlehampton, of which the common and many of the houses are situated on the old beach, and it would leave between the river and the sea the same eastward-extending spit of beach such as we find at the mouths of other rivers on the south coast. A somewhat similar case is seen at Seaford, where the ancient spit of beach, at one time known as the Bemblands, lay between the Ouse and the sea, when that river turned eastward from what is now Newhaven.

We should like to make many references to points contained in this old manuscript. There is a short description of the various kinds of fish that are found in the river, and a touch of affection shown for these creatures by the water-bailiff, who during the " fence-month ", or close season, finds it his duty to take them under his care. His duties were to preserve the swans, fowl, and fish, and to watch over the fishermen's " weares, weare-gates, weeles, shutting-nets and other engins whatsoever that may any way entrap or deceave the fish at that time ". He was to see that the meshes of nets were properly sized, and if the rods of the weirs were above the customary size " hee is then to cutt and deface them ".

The second of August is stated to be " swann-hooking or swann-hopping-day ". This is a variant of ' swan-upping ', which is said in the O.E.D. to be the true form of the word, that is, the taking up of the swans or cygnets for the purpose of marking them. The water-bailiff had to decide between the claimants of the cygnets of swans that had wandered from their rightful owners' waters, and to see that the swan-marking was properly carried out, also to claim his dues on such occasions. There is a list of the marks pertaining to the various persons of rank who had the right of keeping swans. In this we have the word ' butted ' frequently, and a note by N. F. Ticehurst that this refers to the pinioning of a wing " by the removal of the part of the wing distal to the carpal joint ". The swan-marks included besides butting on a wing, one or more notches on the beak, slits on the web of a foot, round holes on the web, the cutting off of one or both ' heels ' (hind-toes), cutting off a claw, the burning of initials on the beak, and various combinations and permutations of them.

The powers of the bailiff to prevent the catching of immature fish and the prevention of pollution of the stream were extensive, and it would be of interest to know if they are still maintained. Unaccustomed or unlawful instruments were not to be used, and if discovered they were to be defaced, or cut in pieces, or taken away or repressed. He was to see that there was " no shooting with gunns uppon their waters by reason whereof the swanns and fowle are frayed out of their haunts, and many times killed, especially by shooting at night ".

The extracts that have been made will show that the book is one which will appeal to all lovers of Nature, although the manuscript was not written for that purpose. It will be of considerable value to owners of fishing and other rights elsewhere, whilst to antiquarians it will be a book to linger over and handle with affection. The folding map is of great service in tracing the feeders of the Arun, and the bridges and other spots referred to in the text.

The Colloid Chemistry of Protoplasm.

The Colloid Chemistry of Protoplasm. By Prof. L. V. Heilbrunn. (*Protoplasma-Monographien*, Vol. 1.) Pp. viii + 356. (Berlin: Gebrüder Borntraeger, 1928.) 19 gold marks.

THIS first in a new series of monographs is written by one editor of the series, Prof. L. V. Heilbrunn, and dedicated to the other, Prof. Weber, who has taken an active part in editing the new journal *Protoplasma*. This journal has certainly been very successful as a channel of publication for the stream of experimental records, comment, and criticism which are the visible evidence that the study of protoplasm has been taken up from many new points of view, often only now possible as the result of advances in other sciences, especially chemistry and physics. It has yet to be shown, however, that the very fluid and

tentative generalisations in this field are ready to crystallise into monographs.

At the same time, the literature of this subject grows so rapidly, and has been so scattered, that a general presentation by one writer is very valuable. Fortunately, too, this literature is critically considered by Prof. Heilbrunn. Too often results are cited to-day without any consideration of the experimental technique by which they were obtained. As a result, a rational interpretation of protoplasmic processes is hindered as much by the effort to reconcile inaccurate and irrelevant data as by the experimental difficulties inherent in the subject.

The book is clearly, often even vividly, written, and the author lives up to his own advice: "We must cling to the facts which are broadly and generally true and leave the specific details to gods and encyclopædias." The author is more familiar with the zoological literature, but plants are by no means neglected. A constant attempt is made to link physical and chemical phenomena with morphological changes; this attitude is as valuable as it is rare.

Very few generalisations are probably yet ready for statement in this field. The most positive impression received from the perusal of the book is that the study of protoplasmic viscosity has proved a very fruitful line of attack. It will be a surprise to many biologists to read that the viscosity of protoplasm is often only a few times that of water. This conclusion must still be regarded as controversial, but the author seems to have a very strong case for his rejection of many figures which were more in accord with the prevalent impression of a very viscous 'slimy' substance. The changes in viscosity associated with the process of cell division are analysed. This association is now familiar to biologists, but morphology and colloid chemistry have still many joint problems in the phenomena of cell division.

There seems progress to report in the chapter upon the electric charge upon the protoplasm, where a clear distinction is drawn between the charge upon the surface layer and upon the colloid mass within the cell. When the action of acids and alkalis is considered, there seems little to show for much recent activity. Possibly the behaviour of iso-electric protein deserves more attention than it receives, as also the studies of Michaelis and others upon the permeability of protein-impregnated membranes in relation to hydrogen ion concentration. Certainly it is good to see attention directed to the lyotropic series when considering the action of salts. At one time Loeb's work upon the stoichiometric behaviour of proteins, with acids and bases, had thrust these phenomena too far into the background.

Many pages are given to a surface precipitation reaction, often exhibited by protoplasm when it escapes from the injured cell. Partly through its connexion with the presence of calcium, this reaction is brought into relation with the obscure phenomena of cytolysis and hæmolysis and with the clotting of blood. Cell division and vacuole phenomena are also considered mainly from the point of view raised in this tentative new interpretation of the surface precipitation reaction. The discussion is very stimulating and suggestive, but is of doubtful appropriateness in this monograph. Doubtless these chapters will appear in a more extended form, with full experimental protocol, in the pages of a journal like *Protoplasma*. We can only feel grateful that Prof. Heilbrunn has deferred the congenial task of detailed examination of these, as yet, mainly unpublished experiments long enough to permit the preparation of this more general monograph.

The botanist, by the way, will read with some surprise that "no one seems to have been especially interested in the process of vacuole formation" in the plant. Possibly the long controversy on the subject amongst French cytologists is regarded as too morphological in nature for consideration.

Our Bookshelf.

(1) *The Decline of the West.* By Oswald Spengler. Authorised translation with notes by Charles Francis Atkinson. Vol. 2: *Perspectives of World-History.* Pp. xi + 507 + xxxii. (London: George Allen and Unwin, Ltd., 1928.) 21*s.* net.

(2) *Kalki: or the Future of Civilisation.* By S. Radhakrishnan. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1929.) 2*s.* 6*d.* net.

(3) *Nomades: essai sur l'âme juive.* Par Kadmi-Cohen. Pp. xii + 221. (Paris: Félix Alcan, 1929.) 12 francs.

(1) THOSE who are closely engaged in scientific work are too preoccupied to worry about the future of civilisation. Most of them, if they consider the subject at all, assume that, with science in the ascendant, the future is secure. The books before us, however, take a different view, and raise many important questions. Spengler's theory is well known, namely, that civilisations have their periods of growth, maturity, and decay, and that our European type of culture has passed the summit. Whether or no the reader can accept everything that he finds here will make little difference to the

fascination that the book will exercise upon him. Whatever else he may or may not be, Spengler is never dull: his generalisations, his handling of facts—many of them as unfamiliar as they are interesting—his *aperçus*, make his pages almost as entrancing, at least for the moment, as Gibbon's. Not that he has Gibbon's greatness—perhaps his keen and lively glance is more like Voltaire's. Students of science should read Spengler, if only as a moral discipline; he will suggest to their minds some profound doubts.

(2) Mr. Radhakrishnan's little book is, of course, of a much more limited scope, but it repays reading. His thesis is the familiar one that our ethical and religious development has not kept pace with the spate of scientific knowledge which has engulfed us all. He questions the too commonly held assumption that mechanical technique is equivalent to civilisation.

(3) M. Kadmi-Cohen's book on the Jewish soul is relevant to the subject dealt with in the other two volumes, since it is concerned with the problem of spiritual leadership for Europe. He holds that, much as Europe already owes to the Semitic genius, the debt is not yet complete. J. C. H.

Primitive Beliefs in the North-East of Scotland. By the Rev. J. M. McPherson. Pp. xii + 310. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 12*s.* 6*d.* net.

IT is perhaps owing to the fact that north-east Scotland has been less well served by students that it does not figure so largely as the west in the literature of folklore and primitive belief. That this is not due to a lack of material is shown by the data which Mr. McPherson has collected and published in this book. As he points out, no systematic study of the folklore of this area has been made since the publication of "Notes on the Folklore of the North-East of Scotland", by Dr. Walter Gregor, nearly fifty years ago. Mr. McPherson has here collected and classified the large amount of material which has accumulated since that date, and in addition he himself has examined the ecclesiastical and burghal records which, while wishing to ignore superstitious practices, frequently were forced to note old ways and modes of thought and life in opposition to the views of the Church. Hence much valuable information upon such subjects as well-worship, tree, river and water spirits, fire festivals, and, above all, magic and witchcraft.

This latter subject claims a large share of the author's attention, and the whole of the second part of his book is devoted to the Black Art, which he examines exhaustively and in its various manifestations. It was in this area that some of the most famous of the Scottish witches were found—Isobel Goudie, for example. The actions of which they were accused were among the most primitive cited in all the witch trials. This is especially to be noted in connexion with fertility rites, in which both nudity and the use of urine are recorded. Control of the winds was a common prerogative of the witch, as might be expected in a country in which maritime activities play a large part. Belief in this ability continued until well into the nineteenth century. Although it has been possible to indicate only one or two points of interest in Mr. McPherson's collection, his book is a store of information on every side of old Scottish custom and belief.

Morphologie und Physiologie des Formwechsels der Moose auf genetischer Grundlage, II. (Untersuchungen, ausgeführt mit Unterstützung der Notgemeinschaft der deutschen Wissenschaft zu Berlin und der Gesellschaft der Wissenschaften zu Göttingen.) Von Fritz von Wettstein. (*Bibliotheca Genetica*, herausgegeben von Prof. Dr. E. Baur, Band 10.) Pp. iii + 216 + 10 Tafeln. (Leipzig: Gebrüder Borntraeger, 1928.) 48 gold marks.

THIS is the second part of Fritz von Wettstein's well-known experimental work on mosses, the first part having appeared in 1924. The present contribution deals largely with hybridisation between different species and genera of mosses, and with heteroploidy produced experimentally by Marchal's original method of wounding the sporophyte. By regeneration from a hybrid sporophyte, and subsequent hybridisation again, various unbalanced types can be obtained, in which the chromosomes may be regular multiples, but more sets will have been derived from one parent species than from the other. These are spoken of as heterogenomatic, homogenomatic forms being those derived from wounding successive generations of sporophytes in pure species, or from crosses giving a balance of chromosome sets. In a section on cell-size, a law for the increase of size accompanying various degrees and kinds of polyploidy is worked out.

Extensive comparative studies of the leaves, paraphyses, sex organs, capsules, stomata and cells in all the various kinds of polyploid hybrids form a basis for the analysis of the genetic effects of each chromosome set. This work has become sufficiently extensive to have wide bearings on various fundamental genetical problems; and mosses, in their structure and life-history, possess certain advantages which are not shared by flowering plants. R. R. G.

Handbuch der Vererbungswissenschaft. Herausgegeben von E. Baur und M. Hartmann. Band 1: *Die cytologischen Grundlagen der Vererbung.* Von Karl Bělař. Pp. iv + 412 + 2 Tafeln. (Berlin: Gebrüder Borntraeger, 1928.) 80 gold marks.

WHILE the volume under notice is mainly devoted to the animal side of the cytological basis of inheritance, there is also a considerable amount of well-chosen evidence from plant material. Much of the evidence presented can be found in such works as Wilson's "Cell", but some of the recent developments have been more fully considered.

The earlier chapters deal with such topics as cytomorphology, cell and nuclear division, cell differentiation, fertilisation and parthenogenesis. In later chapters, considerable space is devoted to problems relating to chromosome reduction, individuality of the chromosomes, and the relation of

the chromosomes to heredity. The last chapter asks the question whether formed cytoplasmic bodies such as mitochondria are bearers of hereditary characters, and, after considering the evidence almost entirely from the animal side, leaves the answer an open one.

References are made to the author's own experimental work on mitosis. Considerable space is taken up with a summary of recent developments in the genetics of *Drosophila*, and an account is also given of Wettstein's work on the production of polyploid mosses. The book will prove useful to those who wish to keep abreast with recent developments in this field.

Les méthodes nouvelles en analyse quantique (mécanique quantique, mécanique ondulatoire). Par Dr. Julien Pacotte. Pp. viii + 139. (Paris : Albert Blanchard, 1929.) 22 francs.

THE object of this book is to give an account, from as many different aspects as possible, of the new methods in quantum mechanics. The first part, based on papers published before July 1926, contains six chapters. These deal with general quantum principles, Heisenberg's matrix mechanics and Dirac's numbers, de Broglie's waves, Schrödinger's wave mechanics, perturbations, and applications. The second part contains two chapters, which link up the new quantum mechanics with relativity and statistical mechanics.

The author's style makes the book easy and pleasant reading. He takes great care to point out that the different conceptions are not so much different theories as different aspects of the same theory. It is shown that Heisenberg's matrices suggest Schrödinger's work, and conversely. Perhaps some readers will consider that the space devoted to applications is too small. This section deals only with the harmonic oscillator and the hydrogen atom. At present the most successful parts of the new theory seem to be its applications, whereas the theoretical foundations are not as yet very secure, and have even been described as " a dodge, but a very good dodge ".

H. T. H. P.

Fitness for Work. By Prof. T. H. Pear. Pp. 187. (London : University of London Press, Ltd., 1928.) 5*s*. net.

PROF. PEAR has in this little book made an interesting study of fitness for work. He rightly remarks that far more books are written about unfitness. He analyses the aspects of successful achievement which force us to attribute to a worker capacities, abilities, or skills, and then the motives that lead a person to select, continue in, or change a particular work, and finally discusses some current conceptions of the function of work. Stupidity and laziness would almost seem to be out of place in a study of fitness, but the author presents some novel and provocative remarks on the two and shows their relation to such a theme. The final chapter on the question of the value of industrial skill opens up some very vital problems of modern industry. Two apparently opposite tendencies are clearly visible in the modern State : on one hand, there is an undoubted increase in the application of mechanism, with a corresponding diminution in the need for personal skill, but on the other, the very mechanism itself demands more people to adapt and adjust it, that is, to deal intelligently with mechanism, and modern organisations demand still greater skill on the part of those in authority.

Prof. Pear's book should appeal to a wide range of readers : his style is easy and not technical, so while the psychologist will find much to interest him, the general reader will find no terminological difficulty.

Kurzes Lehrbuch der Chemie in Natur und Wirtschaft. Von Prof. Carl Oppenheimer und Prof. Johann Matula. Zweite neubearbeitete Auflage. Band 1 : *Allgemeine Chemie*, von Prof. Johann Matula ; *Anorganische Chemie*, von Prof. Carl Oppenheimer. Pp. xiv + 566. 23 gold marks. Band 2 : *Organische Chemie*, von Prof. Carl Oppenheimer. Pp. xiv + 471. 19 gold marks. (Leipzig : Georg Thieme, 1928.)

THE authors have accomplished the considerable feat of giving a comprehensive delineation of present-day chemistry within the limits of little more than a thousand pages. The account is well proportioned and up-to-date. Particular emphasis has been laid upon the underlying principles of the science, and upon its relationships to biology and technology. The introductory section of 258 pages by Prof. Matula forms an admirable preparation for the succeeding systematic treatment of inorganic (pp. 294) and organic (pp. 453) chemistry by Prof. Oppenheimer. The work offers at a reasonable price a useful German text for advanced students, teachers, biological chemists, and all who are interested in the industrial applications of chemistry.

Matter, Electricity, Energy : the Principles of Modern Atomistics and Experimental Results of Atomic Investigation. By Prof. Walter Gerlach. Translated from the second German edition by Dr. Francis J. Fuchs. Pp. xii + 427. (London : Chapman and Hall, Ltd., 1928.) 30*s*. net.

THIS volume covers a wider field than is usual in a short treatise on atomic physics, and touches upon most of the important work done between about 1910 and 1926. It includes sections on atomic rays, superconductivity, conduction in crystals, spectrophotometry, and electrically and optically controlled chemical reactions, in addition to the more usual topics, and if it were well translated, would be invaluable both as an advanced text-book for honours classes in physics, and as a survey of the subject for research workers in other branches of experimental science. Dr. Fuchs has, however, failed to do justice to the original, and his translation can only be recommended as it stands with the warning that the reader must be prepared to be irritated by the many unusual expressions that he employs.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Total Solar Eclipse at Iloilo on May 9.

THE following is a preliminary note on the results of the eclipse expedition of Dr. K. H. Hartline, Mr. W. E. B. Lloyd, and myself. The preparations for the expedition were made at Johns Hopkins University, Baltimore, and were as complete and permanent as possible to reduce to the minimum the work that remained to be done in the eclipse camp. This was necessary owing to the fact that Dr. Hartline was unable actually to make the journey, and Mr. Lloyd and myself had only twelve days in which to put up the apparatus.

Our site was near Iloilo in the Philippines, in the grounds of the Normal School of La Paz, about a mile and a half north of the U.S. Naval Observatory party. Totality lasted 3 min. 42 sec.; but throughout, the sun was covered by a veil of high cirrus.

Ten panchromatic plates (H. & D. 2000, Imperial Dry Plate Company) were given exposures ranging from one to forty seconds with a 5-inch visual Alvan Clarke lens of 6-foot focus through a green Ilford 'Beta' filter transmitting λ4450-λ6950. The focus is good and the shorter exposures show much inner coronal detail. Longer exposures bring up streaky cirrus which confounds coronal detail; yet on these one can trace one streamer to three solar diameters from the limb.

Our intention was, if fine, to get extreme coronal extension by the use of these very rapid plates and the filter which would diminish the scattering of the light. In that the very considerable cloud veil thwarted us; but we feel that, under the conditions obtaining, had it not been for our filter, we should almost certainly have got the inner corona only.

Using a neo-cyanin dyed plate and an infra-red filter, we gave a single exposure of about 200 sec. with a 3-inch rapid rectilinear lens of 24 inches focus (*F* 8). This plate-filter combination was sensitive between about λ7000 and λ9000 with a maximum at λ8500. On this plate the corona is completely confined to within half a diameter of the sun from its limb, is extremely intense—practically 'burnt out'—and has a very abrupt edge. We believe this effect to be far too marked to be attributed entirely to the steep intensity gradient of the photographic combination; but it will be necessary to decide this point on returning by measuring the plates with a micro-photometer, etc. Should the effect prove to be real, it will confirm the view that the light of the outer corona is entirely sunlight scattered by particles very small in comparison with the wave-length of light.

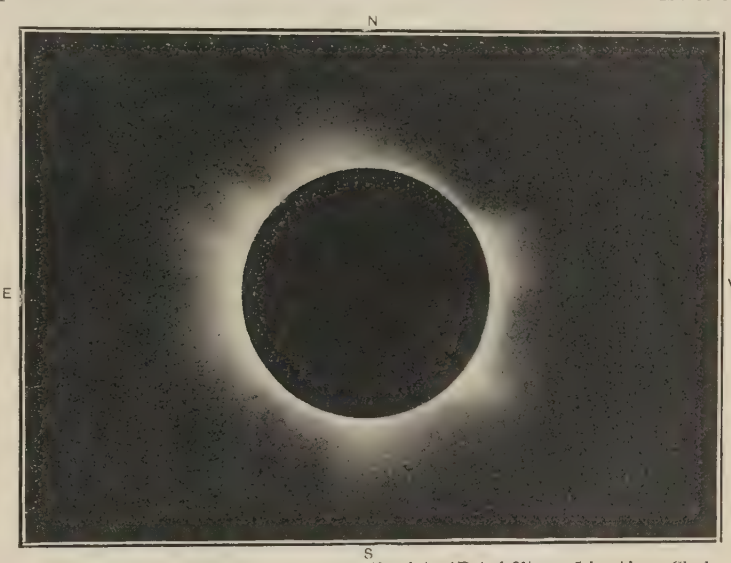

FIG. 1.—One second exposure. Panchromatic plate, 'Beta' filter. 5-in. Alvan Clarke lens, 6-ft. focus.

FIG. 2.—Two seconds exposure. Panchromatic plate, 'Beta' filter. 5-in. Alvan Clarke lens, 6-ft. focus.

Another effect on this plate which will also require confirmation by measurement, etc., is an apparent filling-in on the infra-red plate of what on the panchromatic plates are wedge-shaped gaps in the corona extending in towards the limb. If this effect turns out to be real, it would suggest intervening screens of particles large enough to blot out visual rays but small enough to transmit those of the near infra-red.

Lastly, this infra-red plate is the only one on which no cloud appears; it has completely penetrated—or rather *ignored*—the intervening cirrus.

The cloud badly interfered with our attempt at infra-red spectroscopy—for which the *quantity* of

light was all-important. In this a similar neo-cyanin plate was used with infra-red filter in conjunction with a concave objective grating (kindly lent by Prof. R. W. Wood), $2\frac{1}{2}$ in. × $3\frac{1}{2}$ in. aperture, 15,000 lines per inch and about 5-foot focus. On each of the two flash spectra obtained, only four emission arcs appear, three of which are the infra-red calcium triplet in the region around λ8500-λ8600. Unfortunately, owing to a displacement of the whole spectrum along the line of dispersion, due to a warping by the heat of the wooden tube and finder, the focus is poor. The fact, however, that these arcs appear at all under the conditions of the sky prevailing is hopeful for the use of these plates in the photography of the near infra-red during an eclipse, provided one has a clear sky.

In addition, two fairly successful colour pictures were made of the corona with the new Du Fay colour process film (kindly supplied by the Imperial Dry Plate Company).

REGINALD L. WATERFIELD.

Chicago, July 13.

Penetration of Rocks by Electromagnetic Waves.

DURING the month of June, research work has been carried out at the Mammoth Cave, Kentucky, under the joint auspices of the United States Bureau of Mines and the Geological Survey of Canada, by permission of both of which this communication is being published. The disputed question of the extent to which wireless waves will penetrate into the earth has a high scientific interest, and it bears directly on some practical modern methods of geophysical prospecting for underground conductors such as the sulphides of lead, iron, and copper.

Previous investigations have been made at the Bureau of Mines' Pittsburgh coal mine, in the Caribou Mine, Colorado, and in the Mount Royal Tunnel, Montreal. An account of the experiments may be found in *Technical Paper* 434, pp. 37-40, Bureau of Mines, Department of Commerce, Washington, D.C., and in the *Proceedings* of the Institute of Radio Engineers, Vol. 17, No. 2, Feb. 1929. References to the subject have also appeared in the columns of NATURE. All this work has been of a dubious character because of the presence of iron pipes and rails, and of copper conductors connected with electric lighting. There were three schools of thought; some claimed that the radiations came through the entrance, others that the waves passed through the rock, while the remainder considered that the effects were transmitted along wires, pipes, and rails. Probably all three paths are available, but certainly the Mount Royal experiments proved beyond question that the short waves of length 40 metres (7500 kilocycles) failed to enter the tunnel by any of these means for more than a few hundred feet. Longer waves, broadcasting upwards, were heard and measured throughout the entire three and a half miles of tunnel.

To settle the question, Mammoth Cave, Kentucky, was selected for experiments and it proved a fortunate choice. This cave has not been electrified for illumination, and the managers were good enough to remove telephone wires. There are no conductors whatever in the cave except here and there short lengths of iron hand rails. The exits are filled by and sealed with the waters of Echo River and the River Styx, which flow into Green River. A few years ago a new entrance was found and some electric wiring introduced; this is four miles away overland and eight miles away by cave. A careful survey was made both under and above ground so that corresponding points could be located and levels known. Most of the work was carried out above River Hall, with 300 feet of overburden, about 200 feet of Mammoth Cave limestone, capped by 100 feet of Cypress sandstone. The resistivities of these rocks *in situ* were ascertained by electrical prospecting to be of the order of 10,000-20,000 ohm-cm.

Broadcasting Wave-length.—The words and music from Louisville, Nashville, Cincinnati, were received on a No. 26 Portable Radiola superheterodyne six-tube set, and the bearing was taken with the small loop which is part of the apparatus. These signals were traced into the cave from the entrance and were lost at 500 ft. from the mouth, where the overburden is 150 ft. Yet under the Mammoth Dome, 1000 ft. in the cave, capped by an ascertained thickness of 75 ft., mostly sandstone, the signals were clear enough, and these were traced along a rather narrow tunnel for 300 ft., when the thickness was 150 ft.

On a later occasion, Messrs. Joyce, Barlow, and Kidd took a three-hundred-foot aerial and gave three turns of it round the loop, so as to form a close coupling, and led the other end to the ground. In this manner there was at night good audible broadcasting in River Hall 300 ft. below the ground and more than a thousand feet from the entrance, at a point approached by the famous tortuous passage well named the Corkscrew. Next night, signals and speech were also audible at Echo River, reputed to be 350 ft. underground. The conclusion is irresistible that waves from distant stations can be detected under 300 ft. of sandstone and limestone, waves which do not come through the entrance, and do not pass along conductors.

Long-wave Stations.—Code signals from about six stations (Long Island and others ?) were heard on a loop with a Model RE low-frequency receiving equipment, consisting of an antenna coupling unit, a radio frequency amplifier, a low-frequency receiver, and a tuned audio amplifier. These signals were clear enough to hear, but their intensities were hard to measure, partly owing to static. The wave-fronts appeared to be mainly vertical, and the waves must therefore have been travelling through rock rather than down from above. The reception was again at River Hall, 300 ft. below the surface plateau near the camping ground of the Mammoth Cave Hotel. The bearings of these signals obtained above and below ground were nearly identical. This picture of a wave, with its front mainly vertical, travelling through the rock, just as through the air, is rather novel. We could pick up these unidentified stations with three turns of wire on a four-foot-square frame, and we obtained bearings therewith.

Horizontal Wave Fronts.—A circular horizontal transmitting loop, 100 ft. in diameter, was placed on the ground, and the insulated wire could be tapped so as to give one to ten turns as required. A rectangular receiving coil of three turns 40 × 10 sq. ft. was placed on the floor of the cave at River Hall (300 ft. down). Currents of known magnitude of about half an ampere were introduced into a single turn of the loop, using a gasoline engine generator to excite an oscillator. The high-frequency loop current was modulated by applying a 500-cycle alternating current potential on the oscillator plates. The frequency was varied by steps of ten, from 20 to 110 kilocycles. The received voltage on the coil was measured in microvolts, and averaged about four, suggesting a flux of 10^{-9} lines per sq. cm. in the cave, due to half an ampere in the loop above ground. It was a most remarkable fact that the 20 and 30 kilocycle frequencies boomed out loudly compared with the 40-100 kilocycle frequencies. Measurements made above ground on the same frequencies

showed no such emphasis, and there is a strong suggestion that these frequencies (20-30 kc.) pass with markedly less absorption through the rock. This question must stand over for a fuller investigation. The selectivity did not appear to be a function of the receiving instrument.

Audio Frequencies.—When 500-cycle frequency alternating current was impressed on the full ten turns of the 100-foot diameter circular loop, powerful signals were received with headphones both with and without a three-stage amplifier, using a 400 turn 3×2 sq. ft. rectangular coil, at depths of 100 ft. and of 300 ft. Of particular interest is the fact that detection was readily made without amplifier, in the Mammoth Dome, 900 ft. on an inclined line from the horizontal loop. We conclude that the electromagnetic effects of a 500-cycle frequency passed through 900 ft. of continuous rock. It is intended to publish a full report on these experiments in due course.

A. S. EVE.
D. A. KEYS.
F. W. LEE.

New Determination of the Curvature Radius of Space-time.

As communicated in a cablegram of April 10 (NATURE, April 20, p. 618), my statistical formula, concerning any two groups of stars 1, 2,

$$R^2 = \frac{c^2[\overline{(rv_r/v)_1}^2 - \overline{(rv_r/v)_2}^2]}{\overline{v_1}^2 - \overline{v_2}^2},$$

which is fully derived in a monograph on "The Size of the Universe", shortly to be issued by the Clarendon Press, Oxford, when applied to 29 Cepheids observed by R. E. Wilson of Albany, yielded for the radius R of de Sitterian space-time the value $3{\cdot}0 \times 10^{11}$; when applied to 35 stars of the *O*-type observed by J. S. Plaskett of Victoria, gave $R = 3{\cdot}2 \times 10^{11}$; and when applied to 246 stars taken from Young and Harper's list, $R = 3{\cdot}4 \times 10^{11}$ astronomical units. The latter batch of objects consisted of those of R. K. Young and W. Harper's "1105 Stars" (*Publ.* Domin. Astrophys. Observatory, Victoria, B.C., vol. 3, No. 1, Ottawa, 1924) numbered 500 to 1105, the distances of which, r, equal or exceed 50 parsecs, and the radial velocities of which are less than 100 km./sec. In the formula just quoted, c is the velocity of light, v_r the radial and v the resultant velocity, relative to the sun. (It may be noticed that in Young and Harper's memoir the radial velocities are corrected for the solar motion, but Prof. Young was kind enough to send me a complete list of the original velocities reduced, as usual, to the sun.)

Since the coincidence of these three R-values has seemed very encouraging, I have recently returned to the complete list of Young and Harper's stars, taking in also all those numbered 1 to 499, and, again, satisfying the conditions $r \geqq 50$ parsecs, $v < 100$ km./sec. This gave in all 460 stars, for which all data (r, v_r, μ, and therefore v_t and v) are available. Having divided this material into two groups of 230 stars each, ranging from $r = 50$ to 100 and from 100 to 1000 parsecs, and applied to these the above formula, I had the satisfaction of finding the said R-values corroborated excellently. In fact, the laborious computation, completed on July 11, gave for the nearer sub-group

$$\overline{s_1}^2 = \overline{(rv_r/v)_1}^2 = 2109 \text{ parsec}^2, \quad \overline{v_1}^2 = 1754 \text{ km.}^2/\text{sec.}^2,$$

and for the more distant one

$$s_2{}^2 = 16{,}930, \quad \overline{v_2}^2 = 2185,$$

where s_1, s_2 are, by the way, the actual distances of the several stars from their perihelia. Now, these values, substituted into my formula, give

$$R = 1{\cdot}76 \times 10^6 \text{ parsecs},$$

or $3\ 63 \times 10^{11}$ astronomical units, or 5·74 million light years, in excellent agreement with the Cepheid and the *O*-stars results. In view of the numbers of the last group (460 stars), the latter value has by far the greater weight, and can be accepted with confidence, at least to two figures, as the actual value of the space-radius.

The complete list of data for the $29 + 35 + 460$ celestial objects will be found in "The Size of the Universe", now in proof, and a good number of details will be given sooner, in a paper announced for the next meeting (Aug. 26–29) of the American Astronomical Society at Ottawa.

Here it may still be added that the greatest possible distance apart of two points in elliptic (polar) space is $\frac{1}{2}\pi R$, and thus *nine million* light-years. In view of this, distances such as 140 million light years attributed by Shapley and Hubble to a group of fainter spiral nebulæ are entirely out of the question and (since my radius is stoutly supported by several hundred stars of a variety of kinds) must be subjected to a thorough revision. It seems that even the distances of the Magellanic Clouds, or at least that of the greater one, which of late served as a yardstick for several estimates, has been exaggerated. In fact, in a letter of Feb. 11, 1929, Prof. Shapley, kindly answering a number of my questions, says that the distances of the globular clusters are now being revised, and warns me that "the Large Magellanic Cloud will probably move in considerably when the present study of magnitudes and variable stars is completed". The latter warning was particularly agreeable to me, since I had just at that time derived the Cepheid value 3×10^{11}, which was some 15 times smaller than that obtained from the Magellanic Clouds (in conjunction with the clusters) in 1924. One can now confidently expect that when these objects, Clouds, and all "move in considerably closer, they will also confirm the radius of the order of 3×10^{11} a.u.".

I do not hesitate at any rate to assert that there are, in our world, no distances exceeding nine million light years, so that the present placing of Virgo (140 million) is utterly inadmissible.

The total volume of space being $\pi^2 R^3 = 54 \times 10^{18}$ cubic parsecs, there is ample room for some millions (but not 10^{16}, as Hubble imagines) galaxies comparable in size with our own Milky Way.

LUDWIK SILBERSTEIN.

Cinema Laboratories Corporation,
New York, July 19.

The Possibility of Observing an Emission Spectrum of the Calcium Substratum in the Galaxy.

IN a very interesting paper, "Physical Properties of a Gaseous Substratum in the Galaxy" (*Astrophys. Jour.*, **69**, p. 7; 1929), Gerasimovič and Struve have recently given strong evidence of a uniform gaseous medium of calcium in interstellar space. The absorption coefficient per parsec for the interstellar K line was found by them to be $3{\cdot}4 \times 10^{-4}$. If such a general calcium substratum exists, the question may arise: Is the density of this substratum strong enough to allow the emission spectrum of the Ca^+ atoms to be expected in the spectrum of the night sky?

The mechanism by which the emission spectrum would be produced must be analogous to that giving the spectra of diffuse nebulæ. We have thus two

kinds of emission, partly resonance radiation or line absorption with subsequent emission by steps and partly photoelectric ionisation with subsequent recombinations. In the nebulæ the second mechanism is much more powerful than the first one (compare Zanstra, *Astrophys. Jour.*, **65**, p. 50; 1927), but in interstellar space the two mechanisms take about the same active part in producing the emission spectrum of the Ca^+ atoms.

To begin with the resonance radiation, for example, the K line, the problem of finding the energy density of the interstellar K line on our point in space is, when rigorously treated, rather difficult and leads to a complicated integral equation. The problem is, however, in several respects analogous to that of finding the energy density inside a star. Let us first consider a stellar system embedded in a calcium atmosphere of high density, or in other words, we consider the case when the absorption coefficient for the K line is much greater than $1/R$, R being the radius of the stellar system. As is obvious, the density of the interstellar K line must then be considerable, because the K frequency radiation emitted by the stars must work its way out from the stellar system. The absorption coefficient found by Struve and Gerasimovič is, however, of the same order of magnitude as $1/R$, and, as will be shown in the following, the interstellar K resonance line is not strong enough to be expected in the spectrum of the night sky.

For purposes of simplification, we will consider a stellar system of spherical shape with a radius of 5000 parsecs and with the sun in the centre. Further, we assume both the density of the interstellar starlight E_s and the density of the interstellar K frequency radiation E_k to be constant within the stellar system. The last assumptions are of course not justified if the radius of the stellar system is much greater than $1/\kappa$, where κ is the absorption coefficient, but in our case the assumptions will give a maximum value of the energy density of the interstellar K resonance line in the centre not very far from the truth. Supposing every K line absorption to be followed by K line emission, we derive easily the following expression:

$$E_k/E_s = e^{\kappa R} - 1.$$

With $R = 5000$ parsecs we find $E_k/E_s = 4{\cdot}5$. The energy density of the interstellar K line would accordingly be about 4·5 times stronger than the energy density of the integrated starlight of the same wavelength. Remembering, however, that most of the stars have a strong K absorption line, that the width of the interstellar K line is only about 0·3 A. (Struve and Gerasimovič, *loc. cit.*), and that only 30 per cent of the light from the night sky is due to the stars (Dufay, *Bull. de L'Observatoire de Lyon*, **10**, 9; 1928), we must admit the chances of finding the K resonance line in the faint spectrum of the night sky to be very small. The spectrum of the night sky has been carefully investigated by Dufay, who has kindly communicated to me that the image of the slit on the spectrum plates was never less than 0·04 mm. The dispersion was about 120 A. per mm., that is to say, the interstellar K line would in Dufay's spectrograph be diminished 16 times in comparison with the continuous spectrum of the starlight or 53 times in comparison with the continuous spectrum of the night sky. If there had been no K absorption line in the spectrum of the night sky, the interstellar K line would be superposed on the continuous spectrum and just strong enough to be detected, or about 0·1 magnitude stronger than the continuous spectrum. As, however, the K line is very strong in absorption in the spectrum of the night sky, there is no possibility of detecting the interstellar K emission line.

In the foregoing we assumed every K line absorption in space to be followed by K line emission. This is, of course, not true, as many of the quanta are split up into the diffuse doublet $1\delta - 1\pi$ and the forbidden transitions $1\sigma - 1\delta$. As to the latter doublet, the chances of detecting it in the spectrum of the night sky are, however, rather good. This doublet is not present in absorption in stellar spectra, and the interstellar absorption lines in the spectrum of the integrated starlight are, as is easily shown, more than filled by the resonance lines. As the forbidden doublet (λ7293·43 and λ7325·91) arises both by resonance and by emission by steps, the lines seem to be strong enough to be detected superposed on the continuous spectrum of the night sky. It may, however, be rather difficult to photograph the red part of the faint spectrum of the night sky, but it seems possible, and it would be of considerable interest if such an investigation were carried out.

As was mentioned above, an emission spectrum of the Ca^+ atoms may also arise by electron captures of Ca^{++} atoms. To get an idea of the strength of this process compared with the resonance radiation, I made a calculation for the K line with the following assumptions. The absorption coefficient at the head of the series was equalised with the absorption coefficient of the K line and was supposed to decrease as $1/\nu^2$ (Milne, *Phil. Mag.*, **47**, p. 209; 1924). Further, one capture out of ten was assumed to give rise to the K line. With the temperature and dilution factor for the integrated starlight beyond the series limit given by Struve and Gerasimovič, I found the intensity of the interstellar K line just equal to the intensity of the continuous spectrum of the starlight which corresponds to the temperature 7000° and the dilution factor $5{\cdot}5 \times 10^{-15}$. This mechanism of radiation seems thus to be of about the same power as the resonance radiation.

As a summary of the above, we may propose the forbidden doublet $1\sigma - 1\delta$ to be present in emission in the spectrum of the night sky. The H and K emission lines are, on the other hand, not to be expected. As to an eventual emission spectrum of Ca^{++} atoms, it seems not possible at the present time to make any statement. If emission lines due to interstellar calcium could be found in the spectrum of the night sky, they would give valuable information on the density of the calcium substratum and the size of the galactic system.

YNGVE ÖHMAN.
Observatory, Upsala,
June 25.

The Relative Masses of the Proton, Electron, and Helium Nucleus.

THEORETICAL considerations suggest that the square root of mass may be more interesting and important than mass itself in the case of the ultimate particles of matter. For in the modern theory of matter, electric charge is more fundamental than mass, and the dimensional formula for electric charge e is $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-1}$ in the electrostatic system. Thus e is proportional to $M^{\frac{1}{2}}$. This appears in more definite form if we adopt the classical point of view that the mass of the ultimate particles is entirely of electromagnetic origin. According to the theory of relativity, energy and mass are related by the well-known equation $E = mc^2$. But if the energy E is entirely electromagnetic, $E = \int \frac{1}{8\pi}(F^2 + H^2)dv$, where F and H are the electric and magnetic field intensities respectively. Thus m depends on the square of F and H, corresponding to the fact that it depends on the

square of e. Carrying out this process yields the well-known formula

$$m = k\frac{e^2}{ac^2},$$

where m is the mass of a particle of charge e and radius a. The numerical quantity k (usually given as $\frac{2}{3}$) depends on the particular assumptions made concerning the distribution of charge. This idea of the importance of the square root of mass is of interest, we believe, in connexion with the following facts concerning the relative masses of the proton, electron, and helium nucleus.

If m and M are the masses of the electron and proton respectively, then $\rho = M/m$ is a pure number. Furthermore, on the basis of quantum theory one might expect a dimensionless quantity of such a fundamental character to possess integral properties, that is, it would be an integer, half integer, or the square of an integer, etc.

The value of ρ according to the "International Critical Tables" and the "Handbuch der Physik" (vol. 22, p. 81) is 1847. Birge, however, in a paper on the probable values of the general physical constants (to be published in the *Physical Review* Supplement) gives two values of $(\rho + 1)$, one $(\rho_1 + 1)$ obtained from spectroscopic data, and the other $(\rho_2 + 1)$ from the value of e/m from the deflection experiments with cathode rays. The corresponding values of ρ are:

$$\rho_1 = 1838 \pm 1.$$
$$\rho_2 = 1847 \pm 2.$$

(The opinion has been expressed that ρ_1 and ρ_2 may be really different quantities.)

It is interesting to note that

$$\sqrt{\rho_2} = 42{\cdot}98.$$

This suggests that possibly

$$\rho = 43^2 = 1849, \quad . \quad . \quad . \quad (1)$$

a value which is within the limits of error of ρ_2.

At first sight, 43 seems to possess no distinctive characteristics to qualify it for such an important position in the domain of atomic physics. But

$$43 = 1^2 + 2^2 + 2^2 + 3^2 + 3^2 + 4^2.$$

If we multiply the numbers on the right of the equality by two, we obtain the well-known sequence,

$$2, \quad 8, \quad 8, \quad 18, \quad 18, \quad 32,$$

giving the lengths of the successive periods of the periodic table of the elements. This numerical relationship can be stated in terms of physics in the following words. The number 43 is half the atomic number of the inert gas of highest atomic number, namely, radium emanation.

It is, of course, impossible at the present time to say whether the integral relationship (1) is either exact or significant. But if it should turn out not to be exact, it might nevertheless be significant. The latter point is illustrated by the fact that the integral relationships between the atomic masses as determined by Aston and others are only approximate.

The helium nucleus is usually regarded not as an ultimate particle of matter, but as a structure of four protons and two electrons. Since the latter conception lacks experimental demonstration, it is not certain that it is correct. Perhaps the helium nucleus should be regarded as an ultimate particle just as the proton and electron. The facts seem to indicate that in some sense of the word the helium nucleus is at least 'more nearly ultimate' than the nuclei of the atoms of atomic number greater than two. In the first place, the alpha particle is the only positive particle emitted in naturally occurring radioactivity. Secondly, the experimental data as usually interpreted indicate that the alpha particle is the chief constituent of the nuclei of atomic number greater than two. Furthermore, the packing fractions demonstrate that, if helium is composed of four protons and two electrons, it is an extremely stable combination. Possibly this indicates that in the process of combination the protons and electrons have entirely or almost entirely lost their identity. This latter idea represents a fusion of the usual conception of the helium nucleus and the conception that it is an ultimate particle. (It is of course not impossible or improbable that in all nuclei the component particles have lost their identity.)

Let M_{He} and M be the masses of the helium nucleus and the proton respectively. If the helium nucleus is regarded as an ultimate particle, one might expect M_{He}/M to be the square of an integer just as ρ is. As a matter of fact, $M_{He}/M = \sim 2^2$.

This relationship can be formulated more precisely as follows. If m_H and m_{He} are the masses of the hydrogen and helium atoms respectively, then

$$\frac{m_{He}}{m_H} = \left(\frac{Z_{He}}{Z_H}\right)^2 \cdot \frac{1}{1+\alpha}, \quad . \quad . \quad (2)$$

where Z_H and Z_{He} are the atomic numbers of hydrogen and helium respectively, and α is the fine structure constant. Part of this relationship was pointed out by A. C. Lunn (*Phys. Rev.*, **20**, 1; 1922) before Aston's recent data were available. The value of α computed from Aston's data (*Proc. Roy. Soc.*, **115**, 510; 1927) by equation (2) is $0{\cdot}00724 \pm 25 \times 10^{-5}$, in excellent agreement with the spectroscopic value 0·00729.

In the quantum theory of the electron the mass enters as an arbitrary constant. Perhaps the facts presented here will be of value in constructing a better theory of the proton and electron, which will account for their masses, or at least their relative masses.

ENOS E. WITMER.

Randal Morgan Laboratory of Physics,
University of Pennsylvania,
Philadelphia, U.S.A.,
June 19.

Chromosome Numbers in the Agropyrons.

THE taxonomy of the Agropyrons is in a very unsatisfactory condition, and authorities differ widely in their classification of this genus. This undoubtedly is owing to the wide range of variability existing within the so-called species and also to the large number of intergrading types that occur between these species. The difficulty of classification extends to the seeds; analysts and seed merchants are unable to separate the desirable and undesirable forms with reasonable accuracy.

Since this genus contains a number of native and introduced hay grasses which are particularly well adapted to conditions in western Canada, it is a matter of considerable importance to clear up the foregoing difficulties. It was felt that a cytological study might assist greatly in overcoming some of the taxonomic problems and provide a valuable guide to plant-breeding work.

The plants examined were grown in the greenhouse during the winter of 1928–29. Artificial lighting for a part of the night enabled the work to be carried on in the winter months. Slides were prepared both from pollen mother cells and from root tips. Pollen mother cells proved to be more suitable, and most of the counts were taken from this material. The proper stage was quickly ascertained by Belling's aceto-carmine method. The florets were fixed in Carnoy's 6-3-1 solution for two minutes and then for

twenty-four hours in Zenker's fluid. They were embedded in paraffin and sections 20 μ thick were cut. Newton's iodine-gentian-violet staining method (Huskins, C. L., *Jour. Gen.*, **18**, 315-364; 1927) was used with the above fixing agent. This gave a very brilliant stain, which seemed especially suited to differentiating overlapping chromosomes. In this respect it was preferred to Heidenhain's iron-alum hæmatoxylin, and it has also the advantage of being much quicker than Heidenhain's method. The foregoing method was used for the preparations shown in

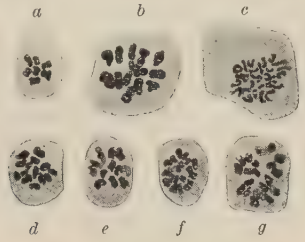

FIG. 1.

a, *A. Griffithsii*, 7 chromosomes; *b*, *A. Richardsonii*, 14 chromosomes; *c*, *A. Richardsonii*, root-tip, 28 chromosomes in the metaphase; *d*, *A. tenerum*, 14 chromosomes; *e*, *A. cristatum*, 14 chromosomes; *f*, *A. repens*, 21 chromosomes; *g*, *A. pungens*, 21 chromosomes. All but *c* show bivalent chromosomes in the metaphase of the heterotype.

Fig. 1, *a*, *d*, *e*, *f*, and *g*. The preparation shown in Fig. 1 *b* was made from a temporary mount prepared by Belling's aceto-carmine method, and this accounts for the swollen condition of the chromosomes. The root-tip preparation shown in Fig. 1 *c* was made from a slide prepared by using Bouin's fixing agent and Heidenhain's iron-alum hæmatoxylin stain.

On counting the chromosomes of the various species studied, they were found to fall into three groups with haploid numbers of 7, 14, and 21.

The groups are as follows:

A. Griffithsii	7	chromosomes.
A. Richardsonii	14	,,
A. tenerum	14	,,
A. cristatum	14	,,
A. repens	21	,,
A. pungens	21	,,

The accompanying illustrations are camera lucida drawings from slides showing clear counts. A Zeiss 1·3 mm. apochromatic objective and × 20 ocular were used in all cases. This gave a magnification of 3200 on the original drawings.

Only typical members of the species were used in determining these counts, and their chromosome behaviour was fairly normal in all cases. Lagging of one or two chromosome pairs was frequently observed in the anaphase of the heterotype in the species *A. pungens* and *A. repens*, and to a less extent in *A. tenerum*. However, the chromosomes did not seem to lag sufficiently to allow any possibility of their being excluded from the daughter nuclei.

Some of the wild plants examined did not exhibit normal chromosome behaviour. A plant which appeared to be *A. tenerum*, with the exception of short awns, was found to be peculiar in this regard. In the anaphase of the heterotype, three and four pairs of chromosomes were found at the equatorial plate just beginning to separate. This resulted in the daughter cells being multinucleate and containing varying numbers of chromosomes. There appeared to be eighteen univalent chromosomes at this stage, and the resulting daughter cells contained from five to thirteen. The plant of course was sterile. This may indicate hybrid origin, and the possibility of natural hybridisation occurring in the field. This phase of the subject, however, will be dealt with more fully in a later paper.

The discovery of a chromosome series in the Agropyrons is of considerable scientific interest as well as of practical value. This is particularly true, since like series have been reported in wheat, oats, and barley, all having a basic chromosome number of 7, and forming groups with 7, 14, and 21 as the haploid numbers. In wheat and oats the varieties of greatest commercial value belong to the 21-chromosome group, while in barley the 7-chromosome group contains all of our commercial varieties. The Agropyrons are intermediate in this respect. *A. tenerum* and *A. cristatum*, our two most promising economic species in western Canada, fall in the 14-chromosome group.

F. H. PETO.

Department of Field Crops,
University of Alberta,
Edmonton, Canada.

Further Evidence of the Carbon Isotope, Mass 13.

A FEW days ago Dr. King and I announced the discovery of an isotope of carbon, mass 13, appearing in the λ4737 Swan band of neutral C_2. Since then, I have found this isotope in two additional sources, namely, in Hopfield's absorption spectrograms of carbon monoxide, and in King's furnace (emission) spectrogram of the λ3883 CN band.

Two years ago J. J. Hopfield and I presented to the American Physical Society (*Phys. Rev.*, **29**, 922; 1927) an analysis of the emission and absorption spectra of carbon monoxide, based on extensive experimental material obtained by Prof. Hopfield with his vacuum spectrograph. The most complete absorption system is the fourth positive group, in which we were able to measure the bands from 0-0 to 15-0 (λλ1544-1199). These bands degrade to the red, and it was noted at the time that a faint second head appeared to the red of each main head, at a systematically increasing distance. We were not able, however, to fit these heads into the band system. I have now carefully measured these second heads and find that they agree quantitatively with $C^{13} - O^{16}$ as an assumed source. The heads can be measured with reasonable certainty in all the bands from 2-0 to 15-0, with the exception of two for which emission lines interfere. The calculated isotope shift, using reliable vibrational constants obtained by Prof. Hopfield and myself, varies from 0·072 mm. to 0·273 mm. (55 cm.$^{-1}$ to 316 cm.$^{-1}$). The arithmetical average *obs.-calc.* value is 0·0035 mm., and the algebraic average 0·0017 mm., in the sense that the observed shift is very slightly less than the calculated.

If the $C^{12} - O^{18}$ molecule is also present, its absorption bands should lie to the *red* of the $C^{13} - O^{16}$ band heads, by amounts varying from 0·006 mm. to 0·024 mm. It is thus impossible, with the present spectrograms, to separate the two isotopes. In all cases the observed $C^{13} - O^{16}$ head is wide enough to include a possible $C^{12} - O^{18}$ head. Thus the evidence is conclusive that $C^{13} - O^{16}$ is present, but is strictly neutral as to $C^{12} - O^{18}$.

The second source of information is King's furnace spectrogram of CN λ3883 (*Astrophys. Jour.*, **53**, 161; 1921). Dr. King kindly loaned me all his CN furnace spectrograms for my work on temperature and band spectra (*Astrophys. Jour.*, **55**, 273; 1922), and I still have this material. He directed attention (p. 162, loc. cit.) to a very faint series of doublets lying between λ3872 and λ3876. I measured these roughly, in connexion with my temperature work, but was unable to fit them into the band structure. I found, however, that two of the six doublets had been observed by Kayser and Runge in the arc spectrum. I now find

that these six doublets are the isotope lines P_{56} to P_{61}, due to $C^{13} - N^{14}$. They have the same doublet separation as the main doublets, and lie just to the red, in each case. In calculating the vibrational shift I have used the constants based on Heurlinger's original analysis, as calculated by Kratzer (*Ann. d. Phys.*, **71**, 72; 1923). For the rotational shift I have used new constants determined by R. T. Birge and W. O. Smith, in an unpublished quantum analysis of this band. The calculated shift varies from 0·228 mm. to 0·451 mm. (0·877 cm.$^{-1}$ to 1·739 cm.$^{-1}$).

Although the isotope lines are very faint, they can under favourable mechanical conditions be measured with reasonable accuracy. Excluding P_{56}, which lies too close to its parent line to measure properly, the observed isotope shift averages 0·014 mm. greater than the calculated, with an average deviation from the mean of only 0·0033 mm. This indicates a small error in the vibrational constants, or an electronic shift of this magnitude (0·05 cm.$^{-1}$). The latter explanation seems the more reasonable. The calculated isotope lines based on either $C^{12} - N^{15}$ or $C^{12} - N^{16}$ lie far outside the limits of error. There are definitely no other isotope lines observable in this region of the band, so that one may conclude that if isotopes of nitrogen exist, they are much less abundant, compared to N^{14}, than is C^{13} compared to C^{12}.

RAYMOND T. BIRGE.
University of California, June 29.

Fossil Records of Mendelian Mutants.

WITH the help of Prof. A. E. Boycott and others, I have been engaged for the past ten years in collecting data for the study of the distribution of variations in natural populations. The species selected for study were the two common and very variable British land-snails, *Helix* (*Cepœa*) *nemoralis* L. and *H.* (*Cepœa*) *hortensis*, Müll. These snails normally occur in populous and well-defined colonies. In habit they are sedentary and apparently seldom move far from their birth-place. Most of the variations taken into consideration are those that affect the colour and banding of the shell. The classical experiments of Lang, and the wider, but as yet mainly unpublished, work of Mr. A. W. Stelfox, have shown that several of the colour and band forms are inherited on simple Mendelian lines. Both species are recorded fossil from the Red Crag of Butley (Pliocene) and subsequent strata, and *C. nemoralis* from the Miocene of France (A. E. Ellis, "British Snails", 1926). Mr. J. W. Taylor in his monograph of the land and freshwater Mollusca of the British Isles gives numerous records of the geological distribution, and says of *C. hortensis* that in a pleistocene deposit (Ightham, Kent) the five-banded and unbanded forms were about equally numerous. To-day, bandedness is known to be a simple recessive to unbandedness in both species. Mr. W. J. Wintle (*Proc. Malac. Soc.*, **16**, 171-8; 1925) reports that on Caldey Island, *C. nemoralis* is very common as a living snail and as a pleistocene and holocene fossil. He states that among the living snails the unbanded form seems rather more common than the banded forms but that the reverse is true of the pleistocene shells. In neither of these cases, however, are any figures quoted.

In the living colonies studied by me the various phenotypes, as might be expected, occur with very different frequency; and the frequencies of any one phenotype may show a significant difference in samples separated by only a few yards. But on the whole series of colonies, banded types, taken together, are more prevalent than the unbanded form. Fortunately, the banding of the shell is easily seen in fossil material; detailed data, therefore, of the frequency of the different types in fossil samples could be obtained and would be of considerable interest from the point of view of genetics and natural selection theory. I am very grateful to Mr. A. S. Kennard, who has kindly supplied me with the figures for three fair-sized samples, each containing both species, from deposits near Goodwood. The samples are dated "Early Iron Age" and "Neolithic"; among the *C. nemoralis* there are four types, and among the *C. hortensis* two types, that are known to be inherited in a simple Mendelian manner. In all three samples the banded types taken together are numerically superior to the unbanded shells and the frequencies of the different types are just such as might be found to-day.

I need scarcely say that I should welcome any further data, references to already published data, or fossil material bearing on this point.

C. DIVER.
40 Pembroke Square,
Kensington, W.8, July 17.

Mimicry.

PROF. MACBRIDE'S reply to my criticisms of his views on mimicry, which appeared in NATURE of May 11, has just reached me. Before this letter reaches England others may have dealt with this, but I would ask indulgence for a few remarks.

(1) It is to be regretted that opponents of the explanation of mimicry by natural selection so frequently rely upon arguments which overlook recorded facts. Such an argument was noted in section 9 of my article, and now Prof. MacBride quotes Bergh as evidence that butterflies are not eaten by birds. I would refer him to the discussion of this subject in Chapter x. of "A Naturalist on Lake Victoria", and to the following readily accessible publications: *Trans. Ent. Soc. London*, Part 3, pp. 353-71, 1902; *Proc. Ent. Soc., London*, pp. xxxii-xliii, 1915; *Jour. Linn. Soc.*, Zoology, vol. 33, 1919.

(2) Prof. MacBride states that the school to which I apparently belong gives no explanation as to how variations originate, and that "the real problem for science is how 'what is there' came into existence". That is one problem: another is why only a certain proportion of what came into existence survives to be included among 'what is there'. It appears to me that it is with the latter problem that mimetists are primarily concerned, as opposed to the former, which is one for geneticists.

(3) Regarding the influence of food, Prof. MacBride suggests that the study of such factors is the only means of solving the problems of animal coloration.

I would ask him to consider again the last paragraph of section 3 of my article, and whether he would attribute the wonderful similarity in appearance between *Planema* and *Pseudacrœa* to a similar effect of widely different food-plants upon larvæ not at all closely related to each other?

G. D. HALE CARPENTER.
Entebbe, Uganda.

Statistics in Biological Research.

AWAY on holiday, I see in my copy of NATURE of July 20, p. 93, a letter on this subject from the distinguished statistician who uses the *nom de plume* of 'Student'. I regret that from some inadvertency he should have dated his letter from the Galton Laboratory, University College, London, an address to which, however much we may regret it, he has no claim. I feel sure that he will recognise, on fuller consideration, that the task of a director of a laboratory would become impossible if anyone could use its address without first obtaining the permission of the director.

KARL PEARSON.

The Bicentenary of Thomas Newcomen.

AMONG the vast number of ingenious inventors whose work is the heritage of to-day, a prominent place must be accorded to Thomas Newcomen, who invented the atmospheric steam engine. Newcomen died in London on Aug. 5, 1729, two hundred years ago. Steam power, which is now of universal application, drives our factories, propels our ships, transports our trains, and waters, drains and lights our cities, raises our minerals, ventilates our mines, irrigates our fields, and ministers to our needs in a thousand ways. If for certain purposes oil and gas have displaced steam, it should be remembered that the first airship, the first aeroplane, and the first self-propelled carriages were driven by steam, and the internal combustion engine itself owes much to the steam engine.

Newcomen's first engine, that near Dudley Castle, was erected in 1712. Fifty years later, similar engines were to be found all over Europe, and a hundred years after that the total horse-power of the steam engines of the world amounted to some twenty millions, while to-day this total runs into hundreds of millions. Whether we contemplate the crude constructions of Newcomen, the stately beam engines of a later day, the whirling high-speed engines which drove some of our first dynamos, or the magnificent machinery found in our ships and power houses to-day, we cannot but admire the skill, ingenuity, and resource which has given man so adaptable and so powerful a means of multiplying his efforts. The steam engine, indeed, has changed the character of our civilisation, and among all the hundreds of men who have applied their minds to the problem of steam power, none deserves recognition more than Thomas Newcomen.

"The engineer", it has been said, "pre-empts and conveys to society the benefits of the experiments and discoveries of the scientist. This contribution is vital; for he finds practical and economic obstacles that tax his ingenuity to the utmost; and the joy of solution, coupled with the satisfaction of achievement, is his reward. For success he needs all the knowledge the pure scientist has acquired and all the experience the man of practical arts has accumulated." This interdependence of abstract science and engineering progress is nowhere more clearly manifest than in the history of the steam engine. The engine of Newcomen was the outcome of the application of the physical discoveries of the seventeenth century; the greatest improvement in the engine during the eighteenth century was due to the discovery of the theory of latent heat by Black and Watt, while the appearance of Rankine's treatise on the steam engine in 1859, in which for the first time a sketch of the new science of thermodynamics was incorporated, marks another epoch in its progress.

The discussions of the present time on the properties of steam and the refined investigations on its pressure and temperature which are being made in a score of laboratories, have their seeds in the studies of the natural philosophers of Italy three hundred years ago, from which came the first thermometers and pressure gauges. Speaking of the applications of the forces of Nature to the promotion of human welfare, Simon Newcomb wrote: "The superficial observer who sees the oak but forgets the acorn, may tell us that the special qualities which have brought out such great results are expert scientific knowledge and rare ingenuity, directed to the application of the powers of steam and electricity. From this point of view the great inventors and the great captains of industry were the first agents in bringing about the modern era. But the more careful inquirer will see that the work of these men was possible only through a knowledge of the laws of Nature which had been gained by men whose work took precedence of theirs in logical order, and that success in invention has been measured by the completeness of such knowledge. While giving all due honour to the great inventors, let us remember that the first place is that of the great investigators, whose forceful intellects opened the way to secrets previously hidden from men." In doing honour to Newcomen, we therefore pay homage not only to a great inventor, but also to those students of science through whose work the steam engine became possible.

Of the Newcomen steam engine we know a great deal; of Newcomen's life very little. Born at Dartmouth and baptized in St. Saviour's Church on Feb. 28, 1663, he was the son of an Elias Newcomen and great-grandson of another Elias, who graduated at Cambridge in 1568–69, and for many years was rector of the pleasant parish of Stoke Fleming, near Dartmouth. Newcomen himself learned the trade of an ironmonger at Exeter, and afterwards had a business of his own in his native town. But no particulars from which we can form an estimate of his character have come down to us. His fellow-countryman, Thomas Savery, was his senior by about ten or a dozen years, and it was these two Devonshire worthies who first attempted to use fire and steam for pumping water for mines.

Savery's patent was obtained in 1698, and this included the plan of obtaining a vacuum by the condensation of steam. But prior to Savery's patent had come the invention of the barometer, the measurement of the pressure of the air, the invention of the air-pump, and the work of Torricelli, Pascal, and von Guericke had been succeeded by that of Boyle, Mariotte, and Hooke. Then, too, Huygens had made a piston descend by the weight of the atmosphere after he had obtained a vacuum beneath it by the explosion of gunpowder, and Denis Papin had afterwards suggested the use of steam instead of gunpowder.

This was the pregnant suggestion which was employed in very different ways by Savery and Newcomen—by the former unsuccessfully; by Newcomen with far-reaching effects. Newcomen's engine was like a gigantic balance. At one end

of a great beam hung the pump rods ; at the other hung a piston working in a cylinder, the cylinder being closed at the bottom and open at the top. The action of the engine was simple in the extreme. The cylinder having been filled with steam from a boiler beneath it, a spray of water was admitted to condense the steam and to form a partial vacuum. When this had been accomplished, the atmospheric pressure caused the piston to descend, thus raising the pump rods.

After the erection of the Dudley Castle engine in 1712, others were set up in Cornwall, Flintshire, the Newcastle-upon-Tyne area, London, Königsberg, Cassel, Paris, and in Sweden. No patent was ever taken out by Newcomen, but Savery's patent was considered to cover Newcomen's plan. The method of working naturally resulted in a great expenditure of fuel—about 25 lb. per horse-power per hour—but engines of the type were made until the beginning of the nineteenth century, and one or two were at work within the last twenty years.

The first great improvement in the engine came with Watt's experiment with the Newcomen engine model, still preserved at the University of Glasgow, which led to the invention of the separate condenser in conjunction with an air pump, a system which, as is well known, is still used in all condensing engines.

For a very long time Newcomen's merits were but little recognised. The Dartmouth antiquary, Thomas Lidstone, in 1857, and again in 1873, advocated the erection of a memorial to him at Dartmouth, and the project was at last carried out in 1921, the memorial consisting of a block of Dartmoor granite on which is a bronze plate with a line drawing of Newcomen's engine and an inscription.

Some Problems of Cosmical Physics, Solved and Unsolved.[1]

By Lord Rayleigh, F.R.S.

The Nebular and Auroral Spectra.

After the first period of success in identifying the origin of the spectral lines of the sun and stars with terrestrial materials, certain outstanding cases remained which were obviously important, but in which the identification could not readily be made. The first of these cases to yield was that of helium, which was unravelled while some of the pioneers in astronomical spectroscopy were still active.

Kindred to the hypothesis of helium, so triumphantly vindicated by terrestrial experience, were the hypotheses of nebulium, geocoronium and coronium. The problems epitomised by the two former words have now been solved, though the solution has taken quite a different turn from what was expected by the older generation of astrophysicists.

In the nebulæ are spectrum lines which have never been observed terrestrially. These are not faint members of otherwise complex spectra, such, for example, as we have in nearly all remaining unidentified lines of the solar spectrum, but they stand out, bold and challenging, on a dark background, presenting a puzzle that was the more intriguing from its apparent simplicity. According to spectroscopic experience, now made precise and rational, simple spectra are due to light elements. This, taken with the fact that lines known to be due to hydrogen and helium accompanied the nebular lines, strongly suggested that they too were due to light elements of the class which terrestrially are known as permanent gases. But the fact remained that no one had succeeded in observing them in the laboratory, and as time went on the originally convenient resource of relegating them to an unknown element had become less convenient. For the scheme of the elements became definite, and there was no room in it for new light elements.

More systematic knowledge of spectra in general, and of the spectra of the light elements in particular, was wanted before the question could be resolved. The clue was afforded by the circumstance that important nebular lines occur in pairs, obviously associated by their closeness and their constant relative intensity in different nebulæ and in different parts of the same nebula.

It is found, then, that the frequency difference of the green pair of lines originally discovered by Huggins, and known as N_1 and N_2, is 193 waves per centimetre. I. S. Bowen, to whom we owe the final elucidation of this enigma, sought for an equal interval in the spectrum of doubly ionised oxygen which he was analysing, and found it in the interval between the low-lying levels designated as P_2 and P_1. The lines were attributed to intercombination between one singlet upper level and two lower levels belonging to a triplet, the third being excluded by the rule of inner quantum numbers. To fix the differences of the terms concerned, it was necessary to connect the singlet and triplet levels by an intercombination line observed in the laboratory spectrum of doubly ionised oxygen. This was done by A. Fowler, who, combining Bowen's laboratory data with his own, was able to get a fairly satisfactory check on the observed position of the nebular pair. Practically no doubt remains, in view of the fact that other less well-known nebular lines can be similarly explained as due to singly ionised nitrogen and singly ionised oxygen.

The identification of these lines was made by ignoring so far as convenient the rules of the quantum theory. These rules forbid certain lines which might occur according to the combination principle. When a state of excitation of the atom is such that it cannot directly pass to a lower state without breaking one of these rules, that state is called metastable ; and this is the case which we have in the nebular lines.

The next cosmical problem I wish to refer to is the long outstanding one of the green line of the

[1] From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Cape Town on July 24.

aurora, which was first seen by A. J. Ångström at Upsala in 1868. In this case the enigmatic line is even more isolated than in the case of the nebulæ, since, except in the case of unusually bright auroras, one can see nothing else in the spectrum at all. An apparently exhaustive study of the spectra to be obtained from terrestrial gases by the combined efforts of very many experimenters gave no clue to its origin.

The clue was eventually found by McLennan, who was able to produce the line by heavy electric discharges in a mixture of oxygen and helium, or, better, oxygen and argon. Oxygen is essential, and there is now no doubt that the aurora line is an oxygen line. There is, however, yet more to be done, for we do not know how to get the green line alone or with only the negative nitrogen bands as we see it in the sky. In the artificial spectrum the ordinary oxygen lines and the lines of the inert gas, helium or argon as the case may be, are conspicuous.

The wave-length of the auroral line could not be foreseen or calculated from our present knowledge of the arc spectrum of oxygen. In this case we have only a single line to deal with, and are thus without the invaluable clue afforded in the case of the nebulæ by the frequency separations of a doublet or triplet. There is, however, no difficulty in finding a conjectural place for it in the scheme of the oxygen arc spectrum as given by Hund's theory.

McLennan, arguing from the fact that nitrogen bands do not appear in the spectrum of the night sky, which, however, shows the green line, takes the excitation potential as less than 11·5 volts. This condition excludes very many possibilities. Indeed, if we are to be bound by the selection rules, it excludes *all* the possibilities. So with the example of the nebulæ before him, McLennan waives these rules, and assigns the green line to a transition from one or other of the low-lying metastable states which the theory indicates.

The lowest state of all should be a triplet, and owing to the absence of companions to the green line this may very probably be excluded. If so, only one alternative remains, and the successful determination of the Zeeman effect carried out in McLennan's laboratory is in harmony with the choice so arrived at. An independent investigation by L. H. Sommer, published immediately afterwards, covered exactly the same ground, and led him to the same choice. For the auroral line we have the experimental production from oxygen, but not the numerical spectroscopic relation. For the nebular lines our position is exactly the reverse.

There are other features of the auroral spectrum which are still obscure. I will limit myself to discussion of one of them—the red line of the aurora. Red auroræ are comparatively rare, and when they do occur the distribution of colour presents very curious features. In some cases the ends of the streamers are tipped with red, while the greater part of the length is green. The only reddish aurora which I have been privileged to observe at my home in the south of England (May 14, 1921) was of a different character, the colour ranging rapidly through various shades of purple. The light was distributed in irregular patches high up near the zenith, though predominantly in the north. At the same time its position was highly unstable, and the general impression produced was reminiscent of high potential discharges in highly exhausted vacuum tubes. Vegard has described cases where the whole sky suddenly turned crimson. He has obtained good small-scale spectrograms of the red line, which give the position as λ6322. A determination by V. M. Slipher of the Lowell Observatory gave λ6320.

So far as can be judged from the evidence available, no pair of the low-lying levels of the oxygen arc scheme which McLennan has discussed in connexion with the aurora are suitably placed to yield this red line by combination. We naturally turn to the consideration of nitrogen spectra, which, as is well known, are represented in the blue and violet regions of the auroral spectrum.

I described in 1922 a spectrum in which one of the first positive bands of nitrogen, λ6323, was very much intensified relative to the neighbouring red bands, which ordinarily are of comparable brightness. This spectrum was produced by adding a large excess of helium to the nitrogen afterglow, and the source had a visual red colour dominated by this band. In describing this work it was suggested as a possibility that this was the origin of the red auroral line, and somewhat similar ideas have been revived by McLennan in his recent Bakerian lecture. But there are difficulties to be met. One of the most urgent problems in auroral work is an adequate wave-length determination of this red line from a large-scale spectrogram.

Excitation of Spectra.

We have discussed cosmical spectra so far chiefly from the point of view of the spectroscopist. It will now be of interest to consider the probable mode of excitation of some of them.

Let us consider first the polar aurora; this, as is well known, is closely bound up with exceptional conditions of magnetic disturbance, and these in turn are conditioned by solar influence. As regards the nature of this influence, the theory of Birkeland, elaborated by Störmer, still holds the field. The sun is regarded by them as emitting localised streams of electrically charged particles from limited areas of its surface.

This theory in its original simplicity has required a good deal of patching, and it is difficult to feel much satisfaction with the special *ad hoc* hypotheses which have had to be introduced into it. A stream of particles with a charge of one sign only is open to the criticism that the stream will dissipate itself by electrostatic repulsion, and loses the hard outline which is one of the most essential features. Lindemann has proposed to get over the difficulty by making the stream neutral on the whole, still consisting, however, of charged particles of both signs. Here, however, we lose too much of the magnetic flexibility of the stream. Chapman proposes

(*Continued on p.* 199.)

Supplement to NATURE

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The International Relationship of Minerals.

By Sir THOMAS HOLLAND, K.C.S.I., K.C.I.E., F.R.S.,
President of the British Association.

PRESIDENTIAL ADDRESS DELIVERED AT JOHANNESBURG ON JULY 31.

A FEW years ago, members of the British Association looked forward annually to a generalised statement of the results of their president's own research work in science. The rapid specialisation of science, with its consequent terminology, has, however, made it increasingly more difficult in recent years for any worker to express himself to his fellow-members.

Last year at Glasgow most of us expected that the hidden secrets of crystals would be revealed by one whose capacity for popular exposition accompanies a recognised power for extending the boundaries of science. Instead, Sir William Bragg released his store of accumulated thought on the relationship of science to craftsmanship in a way which gave each specialised worker an opportunity to adjust his sense of relativity and proportion.

If I attempted now to summarise my scattered ideas on the outstanding problems of micro-petrology, I might possibly find half-a-dozen members charitably disposed to listen, and of them perhaps one might partly agree with my theoretical speculations. We have indeed to admit that the science of petrology, which vitalised geological thought at the end of the last century, has since passed into the chrysalid stage, but, we hope, only to emerge as a more perfect imago in the near future.

Coincident with the excessive degree of specialisation which has developed with embarrassing rapidity within the present century, the problems of the Great War drew scientific workers from their laboratories and forced them to face problems of applied science of wider human interest; and the atmosphere of this great mining field—the Witwatersrand—stirs ideas of this wider sort—ideas concerning a field of human activity which, in recent years, has affected the course of civilised evolution more profoundly than seems to be recognised even by students of mineral economics. This must be my excuse for inviting you to consider the special ways in which the trend of mineral exploitation since the War has placed a new meaning on our international relationships.

With knowledge of the shortcomings which were felt during the War, in variety as well as quantity of metals, it was natural immediately after to review our resources, with the object in view of obtaining security for the future. But events have since developed rapidly, both in international relationships and in mineral technology. The evolution of metallurgy during the present century, and the developments in mining on which metallurgy depend, have placed new and rigid limitations on a nation's ability to undertake and maintain a war; consequently, the control of the mineral industries may be made an insurance for peace. Let us first consider briefly how these circumstances have arisen, how each country has passed from the stage of being self-contained in variety of essential products to the most recent of all developments, the change to large-scale production that has tended to the concentration of the mineral and metal industries in certain specially favoured regions which will hold the position of dominance for several generations to come.

BEGINNINGS OF CIVILISATION.

The names of Isis, Cybele, Demeter, and Ceres seem to suggest that the ancient theologians in different lands formed the same conception of those peculiar conditions in prehistoric times which made it likely that a woman—tied for long periods to the home-cave—rather than a man, was the one who first discovered the possibility of raising grain-crops by sowing seed. Whoever it was who first made this discovery was the one who diverted the evolution of man along an entirely new branch, and so laid the foundation on which our civilisation was afterwards built—the beginning of what Rousseau called "Le premier et plus respectable de tous les arts".

Compared with this economic application of observational science, the later inventions, which

seem so important to us—explosives, printing, the steam engine—were but minor incidents in the evolution of civilised activities. Previous uncertainty regarding the supply of the products of the chase, and the dangers which were necessarily attached to the collection of berries and edible roots in the jungle, became less important to the family-man when it was found possible to raise food-supplies nearer home. This discovery was thus not one of merely material advantage; for it necessarily led to the idea of storage, and so opened up a new mental outlook for primitive man.

Then this new possession of field-crops—the acquisition of cultivated real-estate—created fresh cares and new anxieties, which contained the germ of future political problems. In addition to the previous dangers from nomadic hunters and predatory carnivora, new troubles arose from other enemies — herbivorous animals, birds, insects, droughts and floods.

The formation of village-groups for protection, and the development later of tribal communities, resulted necessarily in the radial extension of field 'claims'—what our modern politicians, with careless disregard for geometrical terminology, now call 'spheres of influence'—always dominated by the extending necessities of agriculture, the growing of crops for food, and then, with the scarcity of skins, for textile materials.

The mineralogist and the metallurgist were perhaps before the farmer among those earliest research workers in applied science; but they were small folk, mere specialists in science. They have obtained a place of undue prominence in the minds of our modern students because of the adoption of their products for purposes of terminology in our conventional time-scale for those ages that preceded history. But this is due merely to the durability of implements as index 'fossils', and is in no sense a certain indication of their political and industrial importance.

Then afterwards, long afterwards—indeed, up to historically recent times—national boundaries became extended or were fought for, but still mainly because agricultural products in some form were a necessity for the maintenance of communal life. When British traders first went to India, for example, they extended their influence along the navigable rivers for the trade in vegetable products which were raised on the alluvial lands around; and so British India, as we call it to-day to distinguish the administered areas from the residual native States, is now mainly agricultural. Even when the permanent settlement of Bengal was made in 1793, no one thought of reserving for the State the underlying coal which has since become so surprisingly important. It was the field, and the field only, that was considered to be of commercial and political importance.

Agricultural products, therefore, until recently dominated the political ambitions of national units. Whether, and to what extent, the possession and use of mineral resources may now modify that dominant spirit is the principal question to which I wish to invite attention.

In the evolution of man, as in the evolution of the animals that occupied the world before him, there are no sharply defined, world-wide period limits: the pre-agricultural Bushman still survives and lives the life of pre-agricultural man in the Union of South Africa. The recognition of agriculture as a leading inspiration for acquiring and holding territory has been modified occasionally by 'gold rushes' into lands previously unoccupied, but they have generally had a temporary, often a relatively small, importance. The 'gold fever' may be what our lighter species of newspaper calls 'dramatic', but a fever is a short item in the life of a healthy man; heat-waves do not make climates. Possibly our school children are still told that Australia is noted for its goldfields, but the whole of the gold produced there since its discovery in 1851 is less in value than that of three years' output of Australian agriculture.

Even in South Africa, which produces half the world's supply of gold, the value of the metal is still less than that of the pastoral and agricultural products. It is true that gold and diamonds introduced temporary diversions in the political expansion of South Africa, but the dominant interests of the Union are still determined by the *boer-plaas* and the *weiveld*. The adventures of the Spanish *conquistadores* in the sixteenth century and of their enemies, the sea-roving Norse *buccaneers*, were inspired by stories of gold in El Dorado. Yet the whole of the South American output of gold, even under its modern development, is almost negligible beside the pastoral and agricultural products—wheat, maize, wool, tobacco, coffee, cocoa, sugar, meat, and hides. The total production of gold for the whole continent last year was worth no more than a hundredth part of the surplus of agricultural products which the Argentine alone could spare for export. Truly there is a substantial difference between the bait and the fish, between the sprat and the mackerel.

The discovery and colonisation of a continent are not the only ways in which the lure of gold has often brought results more valuable than the metal itself. The efforts of philosophers from the time

of the Alexandrian Greeks in trying to transmute the base metals into gold resulted in accumulating the raw materials with which Paracelsus laid the foundations of a new chemistry.

Mineral Resources and the Industrial Revolution.

Metals, we know, have been used since early times for simple implements and weapons, but it was not until the industrial revolution in Great Britain that the mechanisation of industries led to any considerable development of our mineral resources, first slowly and with a limited range of products, then on a large scale and with an extended variety.

However, to distinguish clearly cause from effect is not always simple. We were told at school of the remarkable series of inventors who laid the foundation of the textile industries in the north of England, and of the timely invention of the steam engine; its application to mine pumping; the successive construction of the steamer and the locomotive; the production of gas from coal. But the close association of ore, fuel, and flux made it possible not only to improve machinery, but also to increase facilities for the transport of raw materials and their products. When Josiah Wedgwood obtained his inspiration from the remains of Greek art, then being unearthed from the ancient graves of Campania, he first turned to account the raw materials of his native county of Staffordshire, and then promoted canal and road construction to introduce the china clay from Cornwall.

It is obvious that the growth, if not with equal certainty the origin, of the industrial revolution was due to the close association of suitable minerals in England. It was because non-phosphoric ores were still available that, at a later stage, Bessemer was able to give that new impetus which increased the lead of the English steel-maker; and so, when Thomas and Gilchrist came still later, with their invention of a basic process applicable to pig-iron made from phosphoric ores, their invention fell on barren soil in Britain. The new process, however, found applications elsewhere, and, instead of adding to the stability of the English steel industry, it gave the United States the very tonic they required, whilst the industrialists of Germany—where political stability had by then been established—found the opportunity of developing the enormous phosphoric ore deposits of Alsace-Lorraine, which had been borrowed from France eight years before. So it was through the genius of Sidney Gilchrist Thomas and his cousin Percy Carlyle Gilchrist that Germany was enabled in 1914 to try the fortune of war.

For the first half-century after the industrial revolution, Great Britain was able to raise its own relatively small requirements of iron as well as of the other metals that consequently came into wider use—copper, zinc, lead, and tin. The rapid expansion in steel production which followed Bessemer's announcement of his invention at the Cheltenham meeting of the British Association in 1856 brought with it the necessity of going farther afield for the accessory ores and for further supplies of non-phosphoric iron ores.

The next important step in metallurgical advance came in 1888, when Sir Robert Hadfield produced his special manganese-steel; for this led to the production of other ferro-alloys, and so extended our requirements, in commercial quantities, of metals which were previously of interest mainly in the laboratory—vanadium, tungsten, molybdenum, aluminium, chromium, cobalt, and nickel. The adoption of alloys, especially the ferro-alloys, at the end of the last century opened up a new period in the newly established mineral era of the world's history; for, beside the increase in the quantity of the commoner base metals which were wanted for the growing industries of Great Britain, it was necessary now to look farther afield for supplies of those metals that had hitherto been regarded as rare in quantity and nominal in value.

The country in which the industrial revolution originated and gathered momentum, because of the close association of a few base metals, could no longer live on its own raw materials, and never again will do so. Even in peace time Great Britain alone consumes twice as much copper and just as much lead as the whole Empire produces. Meanwhile, developments had occurred elsewhere, notably in Germany and in the United States, where the Thomas-Gilchrist process also had stimulated expansion. Thus, by the beginning of the twentieth century, the industrial activities of the world had entered a new phase, which was characterised, if not yet dominated, by the necessity for minerals to maintain the expanding arts of peace.

From this time on, no nation could be self-contained; a new era of international dependence was inaugurated, but the extent and the significance of the change were not consciously realised by our public leaders until 1914, when it was found that the developments of peace had fundamentally changed the requirements for war. Indeed, not even the German General Staff, with all its methodical thoroughness, had formed what the tacticians call a true "appreciation of the situation". Two illustrations of short-sightedness on both sides are sufficient for the present argument. Up to the

outbreak of war, although the wolfram deposits of South Burma were worked almost entirely by British companies, the whole of the mineral went to Germany for the manufacture of the metal, tungsten, which was an essential constituent of high-speed tool steel. Sheffield still occupied a leading place in the production of this variety of steel, but was dependent on Germany for the metal, which the Germans obtained mainly from British ore.

Under the compulsion of necessity, and without consideration of commercial cost, we succeeded before the middle of 1915 in making tungsten, whilst Germany, failing to obtain an early and favourable decision in war, used up her stocks of imported ore and turned to the Norwegian molybdenum for a substitute, until this move again was partly countered by our purchase of the Norwegian output. Germany then found that she wanted ten times more nickel than Central Europe could produce; so she imported her supplies from the Scandinavian countries, and they, being neutral, obtained nickel from another neutral country, where the Canadian ores—the world's main source—had hitherto chiefly been smelted and refined. We thus realised, not only our dependence on other lands for the essential raw minerals, but also we had the mortification of finding that, through our own previous shortcomings in the metallurgical industries, we were compelled to face lethal munitions made of metal obtained from our own ores.

The political boundaries of the nations, originally delimited on considerations dominantly agricultural in origin, have now no natural relation to the distribution of their minerals, which are nevertheless essential for the maintenance of industries in peace time as well as for the requirements of defence. This circumstance, as I hope to show in the sequel, gives a special meaning to measures recently designed on supplementary lines in Europe and America for the maintenance of international peace, measures which, as I also hope to show, can succeed only if the facts of mineral distribution become recognised as a controlling feature in future international dealings.

Localisation of Mineral Exploitation.

If minerals are essential for the maintenance of our new civilisation, they are, according to the testimony of archæology and history, worth fighting for; and if, according to the bad habits which we have inherited from our Tertiary ancestors, they are worth fighting for, their effective control under our reformed ideas of civilisation should be made an insurance for peace. In so attempting to correlate the facts of mineral distribution with questions of public policy, there is no danger of introducing matters controversial; everyone must agree on two things, namely, our desire and even hope for international peace, and consequently the necessity of surveying the mineral situation as developments in technological science change the configuration of the economic world.

Since the industrial revolution in Great Britain, the increase of mechanisation and consequent consumption of metals has been accelerated with each decade. It is not necessary to quote the statistical returns available for estimating the rate of this acceleration, for it can be expressed in a single sentence which justifies the serious consideration of every political economist: during the first quarter of this present century alone, the world has exploited and consumed more of its mineral resources than in all its previous history, back to the time when eolithic man first shaped a flint to increase his efficiency as a hunter.

To save you from the narcotic effect of statistical statements, I will limit myself to one illustration of this generalised statement; for this special example not only illustrates the rate of general acceleration in exploitation, but also introduces an important subsidiary question, namely, the way in which activity is becoming pronounced, if not substantially limited, to a group of special areas. In the year 1870 the United States produced 69,000 tons of steel; in 1880, $1\frac{1}{4}$ million tons; in 1890, $4\frac{1}{4}$ millions; in 1900, 10 millions; and in 1928, 45 millions.

Figures like these raise questions regarding the future which would take us beyond our present thesis. For the present we can assume with fair confidence that, taking the world as a whole, the depletion of natural stores is not yet alarming, although the rate of acceleration, by reason of its local variation, forces into prominence some international problems which will influence, and if effectively tackled will facilitate, the efforts to stabilise conditions of international relations.

I have elsewhere[1] made estimates of the quantities of metals stored in that part of the outer film of the earth's crust which may be regarded as reasonably accessible to the miner. The actual figures in billions of tons convey no precise mental impression to us, and need not be quoted here, but certain of the outstanding conclusions have a bearing on our present line of argument.

The first feature of surprising interest to the man

[1] Presidential address, Institution of Mining and Metallurgy, *Trans.*, vol. 34, p. lvii, 1925.

in the street is perhaps the relative abundance of those metals with which he is familiar in the arts—copper, lead, tin, zinc, and nickel. Nickel, in spite of its price and limited use, is twice as abundant as copper, five times as abundant as zinc, ten times as abundant as lead, and from fifty to one hundred times as abundant as tin. There are, indeed, among the so-called rare metals some which are distinctly more abundant than lead, although this is the cheapest of the lot in price, and is consumed at the rate of more than a million tons a year.

So one gets at once an indication of two important features. First, the miner works only those deposits in which the metal is concentrated sufficiently to make their exploitation a profitable business; and secondly, the metalliferous ores vary greatly in the completeness with which they have been concentrated in special places to form workable ore-deposits. Nickel-ore, for example, occurs under conditions which conspicuously hinder its freedom of local concentration; and consequently the wide distribution of the metal and its relative abundance bring little comfort to those who are anxious about their supplies of a metal which jumps suddenly into importance with every rumour of war. We are safe in predicting that we shall never recover for use in the arts any fraction of our total supplies of nickel as large as we shall of most of the others which have been mentioned. Indeed, nickel stands apart from the others; for, whilst it is important in peace time and is dangerously important during war, under the present state of mining and metallurgical practice the deposits in the world worth working for nickel can be numbered on the fingers of one hand, and nine-tenths of our supplies come from a single district in Canada.

Before discussing more precisely the significance of this and similar facts on the question of international relationships, let us consider for a moment the nature of our exploitation methods. Our reference to nickel shows that the metalliferous ores vary in their degrees of concentration, and, therefore, in their suitability for working; but, as the result of estimates made for a few common metals, we shall not be far from the average in assuming that we shall never recover more than about one-millionth of the total that lies within workable distance from the surface of our accessible dry land. Another conclusion, based on a similar group of calculations, shows that our greatest total tonnages are not contained in the rich deposits, but in those of low grade.

It follows, therefore, that every advance in metallurgical science and in mining technology that makes it possible to work our low-grade ores adds appreciably to the actuarial value of civilisation; for our mineral resources can be worked once, and once only, in the history of the world; and when our supplies of metalliferous ores approach exhaustion, civilisation such as we have now developed during the last century must come to an end. When a miner raises a supply of ore in concentrated form for the metallurgist, he damages, and so places beyond reach for ever, far larger quantities of residual ore than he makes available for use. When a metallurgist takes over the product of the miner and separates the refined metal for use in the arts, he also incurs serious losses, although not to the same extent. There are thus before both the miner and the metallurgist opportunities for extending the actuarial value of civilisation; and because the cost of labour is the principal constituent in the total bill, and has recently swamped contemporaneous advances in technology, the gradual elimination of manual labour by mechanisation is obviously the most profitable line of research.

Mechanisation carries with it in general a tendency to limit operations to the larger deposits, with the concurrent neglect of those propositions which are widely scattered over the earth, and, though individually small, represent in the aggregate a serious section of our limited resources. So our operations in mining, with the family of industries dependent on minerals, tend more and more to be restricted to a few special regions, where work can be done on a large scale.

The Mineral Age and International Relationships.

With this thumb-nail sketch of the way in which the new mineral era is developing, we are free to examine more closely the influence which this change in the configuration of the industrial world is likely to have on international relationships.

In the first place, it becomes obvious that no single country, not even the United States, is self-contained, whether for the requirements of peace or for the necessities of war. Not even the more scattered sections of the earth that are politically united to form the British Empire contain the full variety of those minerals that are the essential raw materials of our established activities.[2] Between

[2] For purposes of reference I give a list of minerals, showing how the resources of the British Empire, so far as our present information goes, can be relied on. This list has been kindly revised by Mr. T. Crook of the Imperial Institute.

1. *Those for which the world now depends mainly on the Empire*:—Asbestos, china clay, chromite, diamonds, gold, mica, monazite, nickel, and strontium.

2. *Those of which we have enough and to spare*:—Arsenic, cadmium, cobalt, coal, fluorspar, fuller's earth, graphite, gypsum, lead, manganese, salt, silver, tin, and zinc.

3. *Those in which we could be self-contained if necessary*:—Bauxite, barium minerals, felspar, iron ore, magnesite, molybdenum, platinum, talc, tungsten, and vanadium.

4. *Those for which we are now dependent on outside sources*:—Antimony,

them these two—the British Empire and the United States—produce more than two-thirds of the 2000 million tons of mineral that the world now consumes annually. Each of them has more than it wants of some minerals; but, in order to obtain its own requirements at economic rates, each finds it necessary to sell its surplus output to other nations. Each produces less than it wants of some minerals, and so must obtain supplies from other nations to keep its industries alive. Each of them is practically devoid of a few but not always the same minerals, which, though relatively small in quantity, are none the less essential links in the chain of industrial operations. Even if these two could 'pool' their resources, they would still be compelled to obtain from other nations the residual few. For it is important to remember that, unlike organic substance, it is not possible to make synthetic metals, and it never will be; it is not even possible to make artificial substitutes for many essential minerals that are used as such and not merely for their metallic constituents. There is no other mineral and no artificial substance, for example, that can combine the qualities which give to the mineral mica its position of importance in the arts—its fissility in thin sheets, its transparency to light and opacity to heat rays, its stability at high temperatures, its toughness and the degree of its insulating properties. There will never be a synthetic mica.

Thus the international exchange of minerals is an inevitable consequence of our new civilisation; and the cry for freedom of movement, for the 'open door' and for equal opportunity for development, comes into conflict with the unqualified formula of 'self-determination'. Whatever may have been possible before the industrial revolution, when the mineral industry merely contributed to the simple wants of agriculture, when most national units were self-contained, the formula of 'self-determination' has come too late in the world's history to do good without a more than consequent amount of harm. We cannot even live now without the free interchange of our minerals for those of other nations; in the name of civilisation we dare not go to war.

There is one more group of fundamental data to recall before we are in a position to point the practical lessons which follow from the newly established and prospective mineral situation. I have already referred to the way in which economic considerations tend, through large-scale production, to restrict operations to a limited number of specially favoured areas. There was a time within my memory when the primitive *lohar*, a survival of the aboriginal inhabitants of India, could be found in every province, nearly every district. He collected the granular mineral from the weathered outcrops of relatively lean iron-ore bodies, and, by using charcoal as a fuel, turned out blooms of malleable iron in a miniature clay furnace, using a pair of goat-skins to produce the necessary blast. These primitive workers also produced small ingots of steel by the carbonisation of wrought iron in clay crucibles many centuries before the same process made Sheffield famous.

With the large-scale production of steel in western countries, attended by the opening of the Suez Canal, cheaper transport by steamers and the spread of railways from the coast of India, the *lohar* has been exterminated from all but the most remote parts of the country. His history is similar to that of other workers; the small ore-bodies that he used are of no interest to the modern iron-master, and one result therefore of the modern movement is the neglect of a large fraction of our total resources. We are discussing, however, what is actually happening, not what we think should be a less wasteful course of evolution; natural evolution, like 'trial and error' methods, is always wasteful.

Primitive workers in various lands have opened up to relatively shallow depths but small deposits of other ores, and in eastern countries especially, where forms of civilisation extend far back into history, the numerous and widespread 'old workings' have given rise to travellers' impressions of great mineral wealth. But low-grade deposits that the ancient miner could not utilise are now opened up by mechanical methods on a large scale; and, on the other hand, what satisfied the primitive metallurgist in abundance would be of little use to the modern furnace.

We have now to re-value the tales of travellers, which have had a dangerous influence on those who have directed the course of international competition; we have to strike out of consideration the integers of the primitive worker to whom a great tonnage would form a mere decimal point in the modern unit; we have to realise that our mid-Victorian standards of metal production are gone for ever, and that the comforting after-War formula of 'back to normal' is merely a hypnotic drug to conceal the uncomfortable, one might say regrettable, dynamic conditions which have since developed at a speed that is not sufficiently recognised within our Empire.

It is now misleading to speak of the wide distribution of minerals within a country as we could

bismuth, borates, copper, petroleum, phosphates, potash, pyrites, quicksilver, sulphur, and radium.

A corresponding list for the United States was prepared in 1925 by a committee under the chairmanship of Prof. C. K. Leith, and published under the joint authority of the two Mining and Metallurgical Institutions in New York.

have done some fifteen years ago; we must now rule out the smaller deposits, and so form a new picture composed of those concentrations that are on a scale sufficient to support modern metallurgical units.

For this reason it is necessary to review afresh the resources of the undeveloped Far East, which has for many years been regarded as a menace to western industrial dominance. The vague general notion that mineral deposits are evenly distributed throughout the earth's crust has fed the impression that the development of China, which is much larger than the United States, may yet shift the centre of industrial gravity when her great population becomes awakened and organised by western technical science.

It is true that the people of the East are rapidly adopting the methods and using the mechanical facilities of western nations—railways, telegraphs, power factories, steel ships, and other metal-consuming devices; but the critical investigations made by mining geologists, especially since the War, tend, with a striking degree of unanimity, towards recognising the remarkable circumstance that China, as well as other countries of the Far East, is deficient in those essential deposits of minerals on which our mechanised form of civilisation is based.[3]

When China was still an unknown land, it was possible for after-dinner speakers to impress non-critical hearers by talk of the 'yellow peril' and the 'challenge of Asia'; but these expressions have been used without thought of the circumstance that natural resources in minerals now set a rigid limit to power, whether industrial or military. We have known for some time of the natural limitations of India, of Japan, and of smaller political units in the East; but until very recently we have had insufficiently precise data for estimating the quantitative value of the terms 'vast' and 'unlimited' which have been so often applied to China. Assuming that China may yet become a homogeneous national unit, or even assuming that her resources may become developed by Japanese energy, there is very little doubt now that, as an industrial area, the country is deficient in those minerals that form the essential basework of the modern form that civilisation has definitely taken.

The obvious limit in development, as defined by local natural resources, can be extended only to a limited degree by the importation of raw materials from other areas; for a country can buy metals only by the exchange of other products; its buying powers are limited by its selling powers. Abundant cheap labour, assisted by a semi-tropical climate, can produce an exportable surplus of foodstuffs only in limited parts of the Far East; even the so-called luxury products, which to our early navigators formed the inspiration of what we call geographical research, are now obtained elsewhere, and some are being replaced by artificial products evolved from the chemical laboratory.

Dominance of the Western World.

Exploratory work by mining geologists tends more and more to show that the essential mineral products are far from evenly distributed over the land areas of the world. Western Europe and North America have an undue share of those deposits that can be worked on a large scale, and it is the large-scale movement that marks the specialised character of the new industrialism. Anglo-Saxon character would have found limited scope for its energy but for the fact that nine-tenths of the coal, two-thirds of the copper, and as much as 98 per cent of the iron-ore consumed by the world come from the countries that border the North Atlantic. Dr. Wegener might like to add this fact to the data on which he has based his theory of drifting continental fragments.

The industrial revolution, which began in Great Britain, has always been recognised as a dominant phase in western civilisation, but it is now assuming a new character. It spread first to the western countries of Europe, and developed there because of the favourable conditions of mineral resources, but the force of the movement faded out towards the Slavic east and the Latin south; the mechanical industries of Italy are based on imported scrap. When the new industries became transplanted west of the Atlantic, the natural conditions which originally favoured Great Britain were found to be reproduced on a larger scale.

Thus in these two main areas, separated by the Atlantic Ocean, a family of industries based on mineral resources has arisen to dominate the world; for no similar area, so far as our geological information tends to show, seems to combine the essential features in any other part of the world. Other parts of the world will continue to supply minor accessories; and the isolated basic industries associated with coal and iron will supply local needs on a relatively small scale. But political control, which follows industrial dominance, must lie with the countries that border the North Atlantic.

It is only in this region that there is any approach to the state of being self-contained. Yet since the War there has arisen, first in Europe and then by

[3] A comprehensive study of this question, with bibliography, has recently been published by a competent and judicial authority, H. Foster Bain: "Ores and Industry in the Far East", 1927.

imitation in Asia, a degree of national exclusiveness more pronounced than any which marked international relations before 1914. Each small political unit has become vaguely conscious of the value of minerals, and has shown a tendency to conserve its resources for national exploitation on the assumption that they add appreciably to military security.

There is, however, no such thing now as equality of nations in mineral resources; 'self-determination' and the 'closed door' are misleading guides to the smaller nations. Political control may hamper, but cannot stem, the current of the new industrialisation; commercial and industrial integrations are stretching across political boundary-lines; and the demand for the interchange of mineral products will be satisfied in spite of fiscal barriers.

It would have been a shock to our members if, before the War, political problems were discussed from the presidential chair, and party politics may always be inconsistent with the mental products of culture. But the results of science and technology now limit the effects of national ambitions, and therefore dominate the international political atmosphere for good or evil. One is justified always in suggesting non-controversial measures that tend to good; and this it is proposed to do very briefly as the direct suggestion of the new configuration of the mining and metallurgical world.

The League of Nations has accomplished a large measure of international understanding in questions of social value; its influence in forestalling possible causes of war has raised new hopes; but fortunately, so far, it has not been compelled to use any such instrument of force as a blockade, and any such measure that clashed with the vital economic considerations of first-class powers would probably cause stresses well beyond its elastic limits. The more recent and simpler pact of Paris associated with the name of Mr. F. B. Kellogg wants equally an ultimate instrument for its practical enforcement.

It was with this ultimate object in mind that the outline of my argument was drafted after the Glasgow meeting last year; but I am glad to find that my views have since been expressed independently. Senator Capper, of Kansas, in February last submitted a resolution to the American legislature recognising this shortcoming of the simple treaty, and proposing to supplement its moral obligations by a corollary which, if passed, will empower the government on behalf of the United States to refuse munitions to any nation that breaks the multilateral treaty for the renunciation of war.

Senator Capper's resolution, however, still leaves unsolved a residual problem of practical importance. Those of us who had the painful duty of deciding between civil and military necessities in the Great War, know well that there is now but little real difference between the materials required to maintain an army on a war footing and those that are essential to the necessary activities of the civilian population; *materials* essential for one purpose can be converted to *articles* required for the other. Thus if Senator Capper's resolution be adopted by those who have signed the Kellogg Treaty, either sympathy for the civil population would be stirred, or the armies would be still supplied with many essential munitions: the definition of 'conditional contraband' would still remain as a cause for international friction.

A formula, still simpler but equally effective, is indicated by this review of the new situation arising from the essential use of minerals. It is suggested, therefore, as an amendment to Senator Capper's resolution, that the simple words "mineral products" be substituted for "arms, munitions, implements of war or other articles for use in war".

The only two nations that can fight for long on their own natural resources are the British Empire and the United States. If they agree in refusing to export mineral products to those countries that infringe the Kellogg pact, no war can last very long. As our friends across the Atlantic have recently learnt, it is easier to stop exports than to prevent imports: the Customs' officer is more effective, less expensive, and far less dangerous than a blockading fleet.

The confederation of American States has the advantage of forming a compact geographical unit, without inter-State fiscal barriers to hamper the interchange of mineral products. The British Empire, in the words of Principal Nicholas Murray Butler, "has passed by natural and splendid evolution into the British Commonwealth of Nations"; it is composed of geographically scattered and independent political units, among which freedom of interchange, with due regard to local interests, can be effected safely only by more complete knowledge of our resources. Next year the Empire Congress of Mining and Metallurgy will meet in this city to discuss the proposition which I submitted to it at Montreal in 1927; and this address must be regarded, therefore, as an introduction to a movement which one hopes will supply the necessary data, and so facilitate a working agreement between the two great mineral powers that alone have the avowed desire and the ability to ensure the peace of the world.

Summaries of Addresses of Presidents of Sections.[1]

Geology in Colonial Development.

Sir Albert Kitson, who is the Director of the Gold Coast Geological Survey, in his presidential address to Section C (Geology), discusses "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire". Geological surveys are now in full operation and doing valuable work in Nigeria, the Gold Coast, and Sierra Leone in West Africa; in Uganda, Nyasaland, the Anglo-Egyptian Sudan, and the Mandated Territory of Tanganyika in Central and East Africa; and in the Federated Malay States. Many other colonies have had temporary surveys.

After discussing in detail the functions and methods of such surveys, Sir Albert shows that special assistance may be given to various other departments, such as those devoted to agriculture, forestry, water supply, and public works, the latter involving problems of hydro-electric power and sanitation as well as materials of construction and foundations. Some of the practical results achieved by existing surveys have been of great material value. The coal field of Southern Nigeria, discovered in 1909, has so far yielded two and a half million tons of coal, the total net profit to Government being £452,559 to Mar. 31, 1928. The total cost of the Nigerian surveys to the same date was £88,700, less than one-fifth of the profit from one single discovery. In the Gold Coast the specially important discoveries made by the Geological Survey are huge deposits of manganese ore (total production to Mar. 31, 1928, valued at £3,350,706); more than 250 million tons of high-grade bauxite, still undeveloped for lack of railway communication; and diamonds, those found since 1921 being valued at £1,758,348. The export duty received last year by Government from diamonds alone was nearly $2\frac{3}{4}$ times the cost of the Geological Survey for that one year.

The recently established Sierra Leone Geological Survey has already led to the development of large deposits of hæmatite and of alluvial gold and platinum. In Nyasaland, discoveries of deposits of various minerals have been so promising that a prospecting company has been formed with the view to their thorough examination. In Uganda, mining companies and prospectors are advised of areas likely to prove valuable, the normal operations of the Survey being so far mainly geological mapping. Here, moreover, a unique feature is the recent establishment of a seismological station.

Many important discoveries by the above and other geological surveys are also referred to, as well as the invaluable work carried out almost everywhere in connexion with water supplies, constructional materials, and engineering schemes. Sir Albert gives detailed evidence of the great value of geological surveys to young countries, through the application of scientific knowledge and methods, both theoretical and practical, to the discovery of the resources of Nature.

Adaptation.

The general thesis of Prof. D. M. S. Watson's presidential address to Section D (Zoology) is that since adaptation lies at the very foundation of the Darwinian or Lamarckian views of the method of evolution, the assumptions concerning adaptation ought to rest upon the clearest of evidence. A cursory examination shows, however, that this is not the case. Instead, the assumptions that every structure in an animal has a definite use in the animal's daily life or in its life-history, and that an adaptation, that is, a change in structure and by implication also in the habits of an animal, rendering it better fitted to its "organic or inorganic conditions of life", often rest upon no sort of observational basis. Amongst the examples of such fallacious argument cited is that of the enormous development of the depth and complexity of the teeth in the phylogenetic series leading to the modern horse. This alleged adaptation to a change in the food and feeding may be no more than a development associated with the greatly increased bulk of modern horses (fifty times that of their Eocene forerunners), the sustenance of which demanded more food and postulated greater wear in the teeth.

Not all cases of so-called adaptation are so uncertain, but it is vital that investigations should be carried out to decide whether there is any general occurrence of such special relationship between structure and habit, and whether, if it occurs, it is rightly to be regarded as of adaptive origin. In the solution of this pressing problem, physiology, and especially experimental physiology, is likely to play one of its most important rôles in zoological science.

The whole theory of natural selection is based upon the efficacy of specific differences, but the extraordinary lack of evidence to show that the incidence of death under natural conditions is controlled by such small differences, or by physiological differences correlated with such structural features, makes it difficult to appeal to natural selection as the main, or indeed an important, factor in bringing about the evolutionary changes which we know have occurred. At present, its real existence as a phenomenon rests on an extremely slender basis.

The occurrence of a direct environmental effect upon structures, strongly hinted at in some recent experiments, may do away with the need of postulating adaptive changes in, say, the pale coat-colours characteristic of arid regions. Further, the hypothesis that the variable characters separating one geographical race from another are due to a number of genes, all independent and all producing similar effects, may lead to an explanation of the divergence of local races of a species.

[1] The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science, 1929". The volume is obtainable at 6*s*. of all booksellers or from the British Association, Burlington House, London, W.1.

In short, the present position of zoology is unsatisfactory. We know as surely as we shall ever know that evolution has occurred, but we do not know how this evolution has been brought about. The data so far accumulated are inadequate in character to allow us to determine which, if any, of the proposed explanations is a *vera causa*. It appears, however, that the experimental method rightly used will in the end give us, if not the solution of our problem, at least the power of analysing it and isolating the various factors which enter into it.

Science and Engineering.

The address of Prof. F. C. Lea, president of Section G (Engineering), entitled "Science and Engineering", emphasises the importance of fundamental scientific discoveries and the scientific method in modern engineering developments, and suggests that the only hope of solving many of the problems which face the engineer to-day is by supplementary experience with organised experiments.

Engineering is much older than modern science. In the ancient civilisations great engineering works were carried out, but for two thousand or more years little or no progress in structural engineering took place and there was no development in prime movers. The revival of experimental work in pure science, after the fall of Constantinople, led to discoveries of great fundamental importance, and eventually to the development of the steam engine in the seventeenth and eighteenth centuries and to the discovery by Faraday of the fundamental principles of the modern dynamo and electric motor in the nineteenth century.

During the past century very remarkable developments have taken place in structural engineering, and in this development experiment combined with mathematical analysis has played an important part. Thus the important steps made in engineering in recent times, which distinguish the nineteenth and twentieth centuries from all preceding ones, were commenced and made possible by fundamental discoveries in science, and it can be safely anticipated that no new epoch-making developments in the future will be possible unless preceded by new fundamental scientific discoveries.

Having recognised the debt of engineering to pure science for the discovery of new principles and new facts, only part of the story has been told. In the workshop, in design, in choosing materials, very considerable difficulties had to be overcome by the engineer before success was possible. Inventive ability allied with experiments, research in the development of new materials for tools and machine elements, the perfection of machine shop methods, have all contributed, but wherever success has been sure the methods of science have been followed. To-day there is a serious demand being made upon the engineer to utilise the energy resources of the world more efficiently, but the only hope of real progress is in combined laboratory and workshop research and in the development of new technique. In a matter of such vital concern to industry and the community, much more rapid progress could be made if public organisations and the large power-distributing companies and authorities, as well as private firms, accepted the responsibility of the provision of funds for research. In the universities, fundamental work is being carried out, and much more can be done if funds are available; the National Physical Laboratory is doing work of the greatest value, but it is important, yea imperative, that the same scientific methods that guide fundamental work should be used in industry.

There are many problems of vital interest to modern civilisation in connexion not only with the production of power and the utilisation of sources of energy, but also related to structures and materials, upon which the safety and comfort of thousands of people may depend. These problems can only be solved by supplementing the accumulated experience of engineers by direct experiment and research.

The engineer is faced with many unsolved problems, to many of which he must find immediate, if only approximate and tentative, solutions. If experimental science and mathematics cannot yet give him an exact solution, he must still carry on, and in this way much has been achieved. Not infrequently engineers become impatient of science and lay too great emphasis upon experience; but as an effective guarantee of future progress and in the solution of many problems in design, in processes, in materials, as well as in the discovery of new methods, it is necessary, as Francis Bacon would to-day remind us, to apply "natural philosophy . . . to particular sciences, and particular sciences [must] be carried back to natural philosophy".

Archæology in South Africa.

Mr. Henry Balfour's presidential address to Section H (Anthropology), under the title "South Africa's Contribution to Prehistoric Archæology", reviews the conditions of archæological study in the Union. There are few regions which now remain unsearched for traces of early man. Interest in the problem becomes more intense as it is found that the scattered materials belong to one huge complex. Unfortunately, the opportunities for study offered by recent primitive peoples living in the stone age have been neglected. As in the case of the Tasmanians, so the Bushmen of South Africa are passing away and little light can be thrown by the straggling survivors on the true character of Bushman culture. Even the rock paintings and engravings must be studied archæologically. Yet we can note with satisfaction a steady growth in South Africa of a keen interest in archæological problems. There is abundant stimulus to field workers.

It is manifest that the vast African area south of the Zambezi holds an unparalleled wealth of archæological material due to the arrival of a succession of immigrant peoples from North Africa. South Africa is a *cul de sac*, and the less advanced in culture have been forced down to the *cul de sac*. During long ages this sequence of irruptions has resulted in a congestion of heterogeneous ethnic elements leading to an accumulation of culture

relics. The overlapping of cultures led to fusion and confusion, producing complex hybrid industries the elements of which it is the aim of local archæologists to unravel. This is now proceeding apace, thanks to many keen researchers.

The great scientific interest of this material imposes certain responsibilities on the administration. Organisation of research to avoid unprofitable work is desirable, and a carefully selected advisory committee should be appointed. At the present time it is not so much abstract theories as concrete facts that are wanted to establish the relative antiquity, sequence-position, and characteristics of the early industries, their geographical dispersal, routes of migration, and their inter-relationship. One problem requiring careful scrutiny is the evidence of man's antiquity in the Zambezi gravels, where implementiferous gravel drifts lie 400 ft.-600 ft. above the present level of the river in the gorge. One of the most interesting questions for local archæologists is the true culture horizon of the Still Bay industry, of which the finely chipped leaf-blades have by some been taken to be Solutrean, though the technique appears to differ from that of the Solutrean blades of north-west Europe.

Another interesting problem is the 'Kwè, a digging-stick weight of the Bushmen which, on the analogy of other areas, seems out of place in a people whose culture suggests palæolithic affinities. The art of perforating hard stone is in Europe a late development. Did the Bushmen in their southward drift come into contact with some such people as the Gallas, in whose comparatively advanced culture the perforated stone would not be remarkable ?

In South Africa characteristic neolithic types are absent. The transition from stone to iron is abrupt, and there is an absence of linking cultures —a wide unbridged culture hiatus. Although the industries successively introduced offer analogies to the early stone age industries of Europe, and they may be regarded as offshoots from them, it is highly improbable that they synchronise. A migrating culture cannot long continue unchanged. It reacts to new environmental conditions. Certain elements in the complex persist and offer affinities with distant cultures. South African archæology intriguingly suggests culture affinities far ranging in time and space, and also illustrates how they have become attenuated and obscured in the course of long migration.

Problems of Palæobotany.

Prof. A. C. Seward's presidential address to Section K (Botany) is entitled "Botanical Records of the Rocks, with special reference to the Early *Glossopteris* Flora". After dealing very briefly with the earlier chapters of the history of the plant world, with special emphasis on the relatively enormous lapse of time represented by the rocks of the earth's crust older than those which have afforded the records of the oldest known terrestrial plants, a general description is given of the early Carboniferous vegetation and of the richer and more varied vegetation of the latter part of the Carboniferous period. Special attention is directed to the vegetation of the great southern continent of Gondwanaland, which included India, Australia, South Africa, South America, and Antarctica.

The geological age of this southern vegetation—the *Glossopteris* flora—has long been under dispute : it is generally agreed that there was a glacial period of long duration in Gondwanaland when the *Glossopteris* flora was being evolved. Some geologists, notably Prof. Schuchert of Yale University, refer the Palæozoic Ice Age and the early stages of the *Glossopteris* flora to a Permian age ; others believe that glacial conditions prevailed and that the *Glossopteris* flora had already established itself over an enormous area in Gondwanaland before the end of the Carboniferous period.

In other words, the question is : Was there an Ice Age in the region which is now India and in the southern hemisphere at a time when the later Carboniferous vegetation flourished in the northern hemisphere ; or were the Ice Age and the *Glossopteris* flora subsequent to the luxuriant forests of the Coal Age, which covered a considerable part of the world north of the equator ? Evidence recently brought forward by Prof. Schuchert in favour of a Permian Ice Age and *Glossopteris* flora are critically considered. The conclusion reached is that if we could transport ourselves back through the ages into a forest of the northern hemisphere in the latter part of the Upper Carboniferous period, and thence travel by aeroplane to the land that is now South Africa, we should find retreating glaciers and a vegetation in which *Glossopteris* and *Gangamopteris* were prominent plants.

The differences between the Palæozoic and the Early Mesozoic floras is mentioned, and the hope is expressed that a more thorough investigation of South African fossil plants may supply valuable information on the evolution of floras at the critical stage in the history of the plant-world, which occurred at the close of the Palæozoic era. A brief reference is made to the value of fossil plants as tests of climate. The geographical distribution of plants of former ages indicates that climatic conditions in Arctic and Antarctic regions at several geological periods were much more genial than those at the present day. It is pointed out that while there is a tendency to rate too highly the value of extinct plants as guides to climatic conditions, the occurrence of rich Palæozoic, Mesozoic, and Tertiary floras well within the Arctic Circle presents a problem which has not yet been satisfactorily solved. Methods of dealing with this problem are suggested. Finally, reference is made to the importance of studying the geographical distribution of fossil plants with a view to a better understanding of the present distribution of floras over the earth's surface.

Throughout the address allusions are made to lines of inquiry which might profitably be followed in South Africa by students interested in problems connected with the development of the world's vegetation. Prof. Seward pleads for a wider recognition on the part of geologists and botanists, whether professionals or amateurs, of the value of palæobotanical studies in relation to problems of general interest.

Agriculture and the Empire.

Sir Robert Greig, president of Section M (Agriculture), deals in his address with the development of the agricultural resources of the Empire as an obvious means of adding to the wealth of the world. He points out that as trustees for the native populations in the tropical and semi-tropical possessions, development of its natural resources is forced upon the Empire. Administration alone, however good, is not enough; only by increasing the wealth-producing power of these populations can their well-being be secured through better education, sanitation, and freedom from malnutrition and preventable diseases.

The resources of the Empire are mainly agricultural and largely undeveloped. Even in India, the most intensively cultivated part of the Empire, the cultivable waste land is equal to half the present cultivated area, and in Canada, Australia, and South Africa only two or three acres in every hundred are cultivated.

The application of science to the problems of agriculture has already great achievements to its credit. The organisation of research for the development of the Empire offers almost incredible possibilities. But to obtain the best results it is necessary to regard the Empire as a single organism. From this point of view the problems can be outlined, information collected, a campaign planned, and money and men found to undertake research. Conditions are more favourable now for co-operation in research than ever before.

The Committee for Civil Research is in a position to inquire into any non-military problem. The Empire Marketing Board is able to provide funds, and the newly constituted Imperial Bureaux of Agricultural Research can collect and make available the literature on whatever may be the subject of inquiry. These Bureaux, it is hoped, will form a gathering ground for theories and theorists, will act as illuminants and expositors, and eventually as finger-posts to new and profitable roads and by-paths of research.

Thus machinery exists whereby a problem in nutrition, genetics, pathology, economics, or any other science may be attacked simultaneously in different parts of the Empire by many workers acting together. Success has already followed such team work when applied to the investigation of the mineral content of pastures in such widely separated areas as Scotland, Kenya, Australia, and the Falkland Islands.

The problem may arise in several ways: As the idea of some research worker who finds himself unable alone and unaided to deal with it; as the conception of a department of agriculture faced with losses due to animal diseases or crop pests; as the desire of a community to grow and market a new product; or as a clue which emerges from the collection of information by the Imperial Bureaux of Agricultural Research.

The main thing is that the opportunity exists. The Empire presents the largest and finest outdoor laboratory in the world. It provides the greatest extent and variety of facilities for research. The systems of government make it possible, through the Imperial connexion, to co-operate without difficulty or embarrassment. The machinery for co-operation is in being. Funds are available.

By taking thought, and by regarding the agriculture of the Empire as one field for general and comprehensive development, the well-being and prosperity of the nations of the Empire can be increased, and ultimately the wealth of the world as a whole.

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to retain a slight excess of charge of one sign, and in this way is able to arrive at a tolerable compromise.

The search for direct evidence might not seem at first sight very hopeful, but not long ago a sensational suggestion was made by Störmer. His attention was directed by Hals to echoes heard after short-wave (131 metres) wireless signals sent out from Eindhoven in Holland. These echoes have been found by Störmer and Hals at long intervals up to as much as fifteen seconds after the original reception. Now, if we bear in mind that with the velocity of light the longest terrestrial distances only give intervals about $\frac{1}{7}$ sec., it seems inevitable that some extra-terrestrial reflector should be looked for. Störmer finds this in the corpuscular stream as bent round by the earth's magnetic force. Though the boldness of the idea is staggering, it is difficult to suggest any alternative view.

T. L. Eckersley has made an observation on electrical disturbances of natural origin which he interprets as analogous to Störmer's. A click is heard in a telephone attached to a large aerial, which is followed at an interval of about three seconds by a 'whistler' or musical note of short duration. Further whistles follow at intervals of 3·8 sec., each more drawn out than the previous one. The musical notes are regarded as due to the spreading action of a dispersive medium on an electrical impulse. It is only at times of magnetic storm that these phenomena are frequent. Further development of observations of this kind will be awaited with keen interest.

To return to the nebular spectrum: although the main problem has been cleared up in the way described, it would still be an important step to imitate the spectrum in the laboratory, not so much to confirm the origin of the lines as to get direct information about the conditions under which they may be excited. A large volume and high rarefaction (rarity of collisions) is suggested by the nebular conditions, and was plausibly held by Bowen to be an essential. It must be allowed, however, that such experimental evidence as we have at present on passage downwards from metastable states does not definitely point in this direction.

Metastable States.

In discussing the nebular and auroral spectra, we encountered the idea of 'metastable states'. At present this conception is not in a very satisfactory condition. The original idea was of a state which did not allow of direct transition by emission of radiation to the stable ordinary state. Let us compare the levels of the atom to the stories of a building and the optical electron to a man inside the building. The ordinary state of the atom is represented by the man being on the ground floor, and the metastable state by placing him on the first floor. But the internal architecture of our building must be pictured as peculiar. A staircase connects the first floor with the second floor, and another staircase connects the second floor with the ground floor: but there is no connexion between the first floor and the ground floor except by going up higher and coming down again.

Facts which have since come to light require some revision of this. In the nebulæ the electron manages somehow to escape from its prison-house and descend to the level below, not by the legitimate route of going upstairs and down again, but by illicitly breaking through the floor. Abandoning the metaphor, the selection rule which forbids transitions not involving a change in the azimuthal quantum number is violated in all such cases. The inner quantum number rule, which requires that the inner quantum number should not change from 2 to 0 or from 0 to 0 is also violated in one class of cases, and rather meticulously observed in another. This rule permits only the pair of green nebular lines in doubly ionised oxygen which we have discussed; and in deference to it only two are observed, instead of the three which apart from this might have been expected from the triplet ground state. Yet we find the blue singlet line λ4363 of this ion violating the same rule, and the same applies to the analogous case of the aurora line.

In the case of the mercury spectrum, which lends itself well to experimental observation and of which much detail is known, we have laboratory examples of the violation of this rule, as originally shown by experiments of Takamine, Fukuda, and other Japanese physicists. The lines were originally obtained under conditions where a strong electric field was acting, and this was sometimes urged in mitigation for breaking the rule. Again, the lines were of low intensity, and this too was thought to be a partial excuse.

Whatever might have been thought of these apologies originally, their irrelevance was, I think, clearly shown in some experiments of my own, in which one of the 'forbidden' mercury lines was obtained as the second strongest line in the entire mercury emission spectrum, in the vapour passing through a discharge, but altogether away from the region in which the discharge itself was taking place, and consequently in the absence of an extraneous electric field.

In another experiment I was able to obtain the other forbidden line as an absorption line in unexcited mercury vapour, and thus apparently in the absence of any disturbing conditions. In this experiment the quantity of vapour used was very large, about ten million times the amount required to bring out the resonance line of mercury in absorption. The probability of the transition thus indicated is very low, and for the other forbidden line it is apparently still lower. But for all that, as we have seen, this forbidden line can be got in considerable intensity in emission.

The necessary condition in the mercury experiments appears to be a large accumulation of mercury atoms in the relevant metastable state, so that, even with a low probability of transition for the individual excited atom, a considerable number of transitions occur. It has even been proposed to define a metastable state as one with a low probability of transition. This takes us far from the

original conception, and makes 'metastability' merely a question of degree. If this conclusion is accepted, a far-reaching revision of our present notions may become necessary. The general softening of outline on our picture of atomic events resulting from the substitution of wave groups for particles seems likely to afford what is required, and allow the occasional transition downwards from a metastable state.

Unknown Elements of High Atomic Weight.

Although we are no longer at liberty to postulate unknown light elements, we are free up to the present to postulate heavier ones than any known terrestrially. Jeans, as is well known, has made use of this hypothesis to explain the origin of stellar energy. In common with other authorities, he provides it by the destruction of matter, with radiation of the equivalent quantity of energy (mc^2) demanded by the theory of relativity. So far there seems to be fairly general agreement. The difficulties arise when we come to the question of stability, and here agreement is not general. Jeans considers that the source must liberate energy at a rate independent of the temperature. I am not qualified, and shall not attempt, to discuss this point. The object of postulating unknown heavy elements is to endow them with the property of going out of existence spontaneously at a rate which is independent of external conditions, except in so far as ionisation, which involves the removal of some of the electrons from the neighbourhood of protons, tends to hinder the process.

In the known radioactive elements we have, of course, instances of unstable forms of matter, and Jeans regards these as transitional; but it must be admitted that substances which undergo spontaneous disintegration do not at first sight form an altogether satisfactory half-way house between those which are quite stable on one side and those which spontaneously go out of existence on the other. Then we have to explain why these heavy atoms are not found on the earth, which, it is generally agreed, originally formed part of the same mass as the sun. Jeans mentions this difficulty, and gives reasons for thinking that the heavy elements would sink to the interior of the mass, so that the earth, formed from the exterior part of it, would not contain them. That a *vera causa* is here appealed to cannot be doubted; but there seem to be some difficulties in assuming that it operates with enough precision to secure the desired result.

The list of known elements ends with uranium, and we must notice that of the occupants of the 92 places in the list up to and including uranium, nearly all answer to their proper numbers when the roll is called. The only exceptions are 85 and 87; and he would be a rash philosopher who attached much importance to these vacant places, which may be filled up any day. Roughly speaking, we may say that the elements up to uranium are all present, and the higher members assumed to exist in the stars are all absent. It is putting a heavy burden on the mechanism of gravitational separation to expect it to achieve this result. The inventors of ore-dressing machinery would, I should imagine, despair of accomplishing anything like it.

Nature works on a vast scale and with plenty of time at her disposal, and it may well be urged that we must be careful of measuring her possible achievements by our own. We may ask, however, whether the more direct indications available suggest that she has in fact made this separation. If there is this cut between the atomic numbers 92 and 93, we should expect most of 92 to have gone into limbo in order to ensure the *whole* of 93 having done so. Yet 92 (uranium) is a relatively abundant element compared with most, being in fact No. 25 on the list of abundance in igneous rocks. Again, we happen to be in a position to say that, on the earth at least, uranium, so far from having sunk to the centre, is concentrated near the surface.

Assuming that uranium exists on the sun as on the earth, then, as first pointed out by Lindemann, there are strong grounds for thinking that it must be in course of formation there, for the life of uranium is too short in comparison with the probable age of the sun to allow us to suppose otherwise. Those who remember the early development of radioactivity will recall that a parallel argument was successfully used by Rutherford to prove that radium must have originated on the earth before the fact was directly proved that it is being generated here. Radium (it was later shown) is generated from a parent body of higher atomic weight, namely, uranium. Jeans would regard the origin of uranium itself as analogous, and if this analogy is accepted it would require the presence of an element of still higher atomic weight, capable of undergoing radioactive disintegration, but, it is to be observed, incapable, *ex hypothesi*, of dissolving entirely into radiation.

No doubt these are very deep waters, and we can scarcely expect at present to fathom them. What would really be most helpful would be a theory of atomic structure in sufficiently definite agreement with experiment as regards known elements to enable us to proceed to investigate the properties of elements of higher number than 92 with confidence.

On the general question of whether the evolution of elements has proceeded from the simple to the complex, or from the complex to the simple, it does not seem to me very much to the purpose to appeal to evolutionary doctrine and the analogy of organic evolution, in favour of the former alternative. Is it not more to the point that radioactive changes are of the latter class? At present this is a question of scientific taste. Perhaps it is not irrelevant to remark that even in organic evolution degeneration of organisms sometimes occurs, and I do not know whether our biological colleagues are in a position to assert that the whole course of organic evolution may not at some future time be reversed by a change of conditions. At all events, it is something to have formulated the more restricted question of whether uranium now comes into being on the sun by a synthetic or an analytic process. It would seem that this is a well-framed question, and that the answer can scarcely be either *both* or *neither*.

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Physiology the Basis of Treatment.[1]

By Prof. W. E. DIXON, F.R.S.

THE ultimate aim of medicine is the prevention or cure of disease: this practical aspect so far dominates all others that it is often referred to as the healing art; indeed, it is difficult to think of medicine apart from treatment.

The term 'physiology' is usually used to designate the science of function, whether it is studied in broad outline and dealing with the mechanism of action or as the physico-chemical mechanisms leading up to this action. Disease means the unusual functioning of tissues which may be the result of accident, hereditary weakness, or parasitic organisms. Generally it is wrong to speak of this as malfunctioning: the unusual functioning is physiological and perhaps the best for the organism under the unusual conditions. The science of medicine, then, is nothing more than trained and organised common sense based on physiology. It is still usual to speak of it as an inexact science; this is obviously wrong, since medicine uses the same methods as every other science and the results of observation are as definite as those of the chemist or physicist, although it is true that in the complexity of the problem with which the physician may have to deal all the conditions of importance may not be known and the results of an investigation, though correct for the conditions under which it is undertaken, may be misleading.

It is not to medicine as a whole that I wish to direct attention here, but only to that part of physiology which forms the basis of treatment.

When the sciences of physiology and pathology a century ago passed from the realms of natural history to deduction and experiment, they naturally attracted the more original and eager minds in medicine, and the text of the writings of the nineteenth century deals with changes in structure and function. Treatment became neglected, the old shibboleths and rituals of treatment which had held sway for centuries were discarded, and there was nothing with which to replace them. Diagnosis was then and is now far ahead of treatment; diagnosis is often accurate where there is no satisfactory treatment, and yet diagnosis is only a means to the end.

The science of treatment or pharmacology is therefore relatively new; it includes knowledge of all kinds dealing with the treatment of disease or alleviation of suffering. It is the climax of physiology and pathology, devised to subserve a practical end, and forms an important part of the great biological topic of the influence of conditions on the living organism. Few drugs now exist the mode of action of which is not understood, and the goal is not so far distant when it will be possible to introduce into the animal economy a factor which will exaggerate or retard the function of any tissue or collection of cells in the body, leaving the others unaffected; and most of these results have been obtained by the methods used in experimental physiology.

The first object of science is to ascertain facts. Certain facts in physiology are relatively easily ascertained—those, for example, which involve the behaviour of ferments of isolated cells or of tissues, and require well-known chemical or physical methods. Other facts involving the physiology of the whole organism are more difficult to interpret, though they are the basis of the therapeutic side of medicine. More and more is physiology being regarded as the application of physics and chemistry to the phenomena of life. I might go beyond this and say that physiology is getting further and further from practical medicine, and this is the more regrettable as most of the chairs in physiology are connected with the medical schools and because the science of treatment is largely dependent on experimental physiology.

No branch of experimental biology has received less consideration in Great Britain than that of pharmacology: it is also the most neglected branch of medicine, and although the object of medicine is the healing of the sick, it is amazing that medical schools in Britain, often equipped with all other modern laboratories, lack departments of therapeutics. But the advent of institutions for experimental therapeutics is upon us, though Britain has taken little part in the movement. In this connexion we welcome the magnificent buildings of the University of Cape Town, and when the new hospital with its medical school is completed I confidently anticipate that adequate accommodation will be provided for that important branch of applied physiology, pharmacology, and that this will include laboratories of physiology and organic chemistry, which must be in close and direct association with the wards. The enormous importance of one branch of treatment to Africa, chemo-therapy, I will refer to later.

It is not surprising that British pharmacology should be so much behind that of other countries in the production of new curative remedies; practically all come from abroad; I may mention ephedrine for spasmodic asthma, liver extract for pernicious anæmia, insulin, the organic arsenicals, the dyes such as 205, the new anæsthetics local and general, hypnotics, and many others.

It has often been stated that the action of remedies may be best determined by experimenting with them on healthy men. This is not true; quinine is used to treat malaria, yet not one of the subjective symptoms induced in man has the remotest connexion with its curative properties. The same is true of the use of the iodides in syphilis and salicylates in rheumatism. The experiments of Joig and his pupils in 1825 with camphor, digitalis, and other drugs on healthy men added nothing of value to pharmacology. Subjective sensations are, it is true, produced, which are erroneously attributed to the drug which has been taken. Few,

[1] From the presidential address to Section I (Physiology) of the British Association, delivered at Cape Town on July 24.

if any, experiments made on man without the most careful controls are of any real value. Properly controlled experiments have been made, however, with many substances. Precise experiments, for example, have been made both in Germany and America with bromides in epilepsy. In these experiments half the epileptics were given potassium chloride and the other half sodium bromide; after several weeks' use the bromide had decreased the number of attacks, whilst the chloride had no distinct action.

Chemo-Therapy.

At one time hopes ran high that the chemical structure of the molecule might indicate pharmacological action. During the last fifty years, many laborious researches have been conducted with this object: to modify the molecule that it may conform to some required action. But the mystery remains as mighty as ever. It is most probable that subtle energy factors binding the molecule—factors not displayed in a formula—control the action; certain it is that drug action is not determined directly by chemical combination with body constituents, but rather by delicate physical processes such as those of adsorption, solution, and surface tension.

Chemists have as yet not even determined the requirements of the molecule for the production of colour sensation. On the other hand, slight alteration of a molecule already complicated and with a known action has led to the production of many useful compounds, and not infrequently we may foresee the type of action which will occur under such special conditions. Considerations of this nature have led to the synthesis of the new local anæsthetics, antiseptics, antipyretics, diuretics, tropeines, and other useful substances.

Parasites causing disease in man may be crudely divided into worms, protozoa, and bacteria. Chemotherapy, that is, specific therapy of infectious disease, has had marked success in curing disease due to parasites in the first and second of these groups; these diseases are found mainly in the tropics. It has obtained much less success in the third group.

Diseases due to protozoa have an especial significance in Africa, and reference must be made to that area of tropical Africa occupying more than a million square miles in which one form of these, namely, trypanosomes, produce their ravages. Trypanosomiasis is one of the most serious of all tropical diseases and affects both man and beast; it is a scourge which renders vast tracts of land practically uninhabitable and takes its death-toll often in thousands and occasionally even in hundreds of thousands, and yet it is a disease which I believe should be curable if not preventable. The problem is one of wide interest and importance—scientific, humanitarian, and economic.

The members of two groups of chemical substances excel all others in their curative value in trypanosomiasis and spirochætosis; these are the organic arsenical compounds and the dyes. The most satisfactory arsenic compound yet discovered for the cure of trypanosomiasis is tryparsamide. It is less toxic than atoxyl and has a slightly higher therapeutic index; it has a most marked trypanocidal action in animals and has been used with some success in cases of sleeping sickness from *T. Gambiense*. One injection causes the disappearance of the parasite from the blood of man, and if the injections are repeated in courses, the cure may be complete.

Dyes.

Many dye substances have been used in medicine. Trypan red and trypan blue belong to this group. Trypan blue was employed by my colleague, Prof. Nuttall, in piroplasma infections in animals, with results that most South Africans are well acquainted with. Afridol violet, a derivative of diamino diphenyl urea, and some allied dyes have also a powerful action on piroplasma.

How these substances act is not known, for like the organic arsenicals they do not kill the parasite *in vitro*. They have the property, however, of being adsorbed to the blepharoplast of the trypanosome; this adsorption is associated with diminished virulence of the parasite in infected animals, and after successive inoculations through several animals the organ may disappear. This direct action of a drug on a tissue, causing ultimately the complete disappearance of that tissue, is so remarkable that it is worthy of notice, as it represents the first known action of the kind.

The most valuable member of the afridol violet group so far produced was first made in the Bayer laboratory, but its composition was kept secret. It was, however, afterwards synthesised and its formula published by Fourneau, but only after long trials and infinite patience. The chemo-therapeutic index of this substance has the remarkable figure of 200 to 300; and so little as 1/32 mgm. will sometimes cure mice infected with trypanosomes. Fourneau has made many allied substances and derivatives of "205", he has modified the wings of the molecule by the addition of various side-chains, sometimes keeping the wings identical and sometimes changing them by joining two different complexes through the agency of phosgene. The number of such derivatives is obviously legion, and this makes it the more remarkable that he should have succeeded in synthesising "307", which at the present time is superior as a therapeutic agent to all other dyes in trypanosomiasis.

This "307" has a remarkable action on trypanosomes in laboratory animals, being three hundred times more effective than atoxyl. Its discovery has also opened a new era in therapeutics, since it represents the first chemical substance which when administered to man or animals in an infected trypanosome district gives a complete immunity to the disease for several months: it does not necessarily prevent trypanosome infection, but it prevents the effects of the disease. There is much in these experiments that suggests that we are on the fringe of a new pathology, and that our present crude methods of preparing anti-bodies in the future will be replaced by those of the organic and colloid chemist.

Bacterial Infections.

Tuberculosis is another problem of vast importance in South Africa, not only on account of its prevalence amongst susceptible individuals in both the European and native populations, but also because of its association with certain industrial diseases.

Much the most important industrial disease in South Africa is the silicosis produced in the extraction of gold from the conglomerate, both the pebbles and the matrix consisting of quartz. The gravity of pneumoconiosis depends largely on superadded tuberculous infection to which the workers have a predisposition, and in this respect crystalline silica is much more harmful than either amorphous silica or carbon. It may act by direct irritation, by its poisonous properties after solution, by colloidal action, or because it forms locally a nidus suitable for the growth of the tubercle bacillus.

Drugs are employed in tuberculosis either with the object of attacking and preventing the growth of the tubercle bacillus or other organisms with which the disease may be associated, of neutralising poisonous toxins, or of removing or relieving symptoms. It is with the first group that I am now concerned. Two groups of organic compounds are especially remarkable for their chemo-therapeutic action on bacteria. The first group has the quinine complex ; quinine is the methyl-ester of cupreine and it can be reduced by nascent hydrogen to form hydrocupreine. The following table shows the effect of two derivatives of hydrocupreine in arresting the growth of certain micro-organisms :

	Ethyl hydrocupreine (optoquin).	Iso-octyl hydrocupreine (vuzin).
Diphtheria bacillus .	1 in 100,000	1 in 750,000
Pneumococcus . .	1 in 400,000	Negligible
Staphylococcus . .	1 in 500	1 in 16,000
Streptococcus . . .	1 in 1,000	1 in 80,000

The action of optoquin on the pneumococcus and of vuzin on bacillus diphtheriæ is highly specific ; the higher and lower homologues have a greatly diminished effect. Many substances destroy bacteria in the test tube, but these drugs act in the animal body as well as in the test tube, and enough can be given by medicinal doses to animals and men to render the blood of these animals bactericidal.

The second group of drugs which exert a marked action on bacteria are certain derivatives of acridine. Trypaflavin was used during the War for infected wounds : unlike most antiseptics, it acts better in the presence of protein, but is not sufficiently selective or specific on micro-organisms in the presence of body tissues to be of any real value ; it is easily absorbed and readily causes œdema. Rivanol is a more recent derivative of acridine. Morgenroth cured streptococcic infections by injections of rivanol under the skin. The injections to be efficient must be made soon after the infection and in the neighbourhood of the inoculated zone ; rivanol will not cure a blood infection. The destruction of the tubercle bacillus presents two special difficulties : first in the fatty and protective envelope surrounding the bacillus, and second in the small blood supply to the tuberculous lesion.

Hoyle and I have recently investigated two new types of gold compounds in tuberculosis. One of these is a complex aurous salt of ethylenethiocarbamide with the formula $(Au,2etu)H_2O$, where ' etu ' represents ethylenethiocarbamide.

This compound, prepared by G. T. Morgan, is stable, crystalline, and colourless at ordinary temperatures. It is soluble in distilled water, forming a solution neutral to litmus and with a pH value of about 6·2. It was tested for therapeutic effects on both human and bovine types of infection. For the former, inoculations were made subcutaneously into guinea-pigs with 1 mgm. doses of a virulent human strain. All the animals, control and experimental groups, died within a few weeks of one another, and all showed characteristic progressive lesions of similar extent.

It was found that treatment with the gold compound in bovine disease in rabbits prolonged life about 50 per cent when compared with controls. We adopted the arbitrary standard that treated animals should survive at least two or three times longer than the average length of life of the controls before clinical trial should be proceeded with. In view of the wide variations in individual susceptibility, and the difficulty that this entails in drawing sound positive conclusions from a small series of animals, it is absolutely necessary to exercise the utmost caution before arousing clinical expectations.

The second compound tested by us was a complex gold derivative of succinimide, prepared by my colleague, Sir William Pope. This compound is non-ionised and the gold is associated in chemical combination in an internal organic ring. It is a white, crystalline, stable compound at ordinary temperatures, readily soluble in water to a neutral solution.

This substance was tested for therapeutic effect in experimental bovine infections in rabbits. In some animals this treatment was supplemented by injections of potassium iodide subcutaneously ; in no case has any therapeutic benefit been observed. There has been no increase in the lengths of life of the treated animals, and the type and extent of disease at post-mortem examination in treated and control animals has in every case up to the present been similar.

These compounds are interesting because one delays death and the other is entirely without action. They may afford a hint as to the lines on which organic chemists should proceed, and perhaps show that gold in the ionic form is desirable.

The Internal Secretions.

In the last twenty years much evidence has accumulated to show that the glands of internal secretion are responsible for the regulation of growth, of metabolism, and often for our appearance if not for our very character. Exaggeration or diminution in the secretion of one or other of the tissues may induce conditions so decided as to be obvious to everybody, though the effects produced by minor alterations in the co-ordination of the several

secretions may not be so evident. Giants and dwarfs, unusual pigmentation and anæmia, disproportion in the growth of the skeleton, such as enlarged hands and face, bulging deer-like eyes or oriental eyes and beards in women are noticeable to everyone ; excessive fatness or emaciation, a choleric or bucolic temperament cause no comment, yet may equally arise in the victim from a want of co-ordination in the internal secretion.

The gonads present the clearest evidence of the influence which a tissue may exert on metabolism. I will refer only to the ovary. The ovary differs from other organs of internal secretion in that it functions in a cyclic manner, and it is obvious that extracts made from ovarian tissue may exert a different action according to the period of the cycle when they are made. Numerous extracts have been prepared from the ovary which are reputed to exert one or other type of action. ' Oestrin ' is the name given to one such substance : it can be made from many sources, both animal and vegetable, besides the ovary. Oestrin exerts a very definite action in lower animals, but its use in man is so variable and disappointing as to make it valueless in practical medicine. When it is injected subcutaneously into spayed rats and mice it produces typical oestrus with normal sex instincts, and when injected into immature animals it induces puberty ; regular injections at fixed intervals will keep animals sterile.

Many experimental observations show that the corpus luteum is concerned with the rhythm of the oestrus cycle and with the prevention of ovulation. A persistent corpus luteum, both in the case of animals and women, produces sterility, a condition which is cured by its removal.

A third active substance distinct from oestrin and corpus luteum is elaborated by the ovary and was described by Marshall and myself. This substance is water-soluble and thermo-stable, and can be prepared from the ovary at one stage of its cycle only, by maceration with warm saline followed by boiling and filtering. The injection of this substance into animals causes a secretion of pituitrin, and this in turn renders the uterus supersensitive and highly responsive to other forms of stimulation.

Our experiments showed that at one stage only of the ovarian cycle was this hormone elaborated, namely, at the stage when the corpora lutea are degenerating. So long as the corpora are functioning they control the metabolism of the ovary, but when they degenerate control is lost and the ovary liberates the specific substance which excites the pituitary gland to secrete. This means that extracts of the ovary made between the heat periods or during pregnancy are without effect on the pituitary gland, but extracts made just before the heat period or just before parturition induce secretion of the gland. As the significant action of pituitary extract is to sensitise the uterus it is difficult, if not impossible, to avoid the conclusion that these two phenomena are closely associated.

It is not suggested that the ovario-pituitary endocrine mechanism is the sole factor in producing labour pains. No doubt the fœtus itself acts as a direct stimulus, and without the fœtus the intense muscular contractions would not occur, but it is also clear that the onset of labour cannot easily be accounted for without postulating some further exciting cause apart from the fœtus and the uterus.

In conclusion, no romance can be more remarkable than the fact that doctors, by using pituitary extract to stimulate the uterus in pregnancy, should have adopted the method which Nature herself employs and that physiological function is after all a pharmacological action.

Medicine and Physiology.

Civilisation has been responsible for many new diseases. Our food-stuffs in great cities are often preserved and important constituents of fresh foods may be lacking. The science of dietetics has assumed an enhanced importance lately, which is partly due to the artificial preparation of many of our foods. Many experiments have been made in my laboratory to show that certain foods given in excess to animals fed on a synthetic diet, but containing an ample supply of the recognised vitamins, suffer from poisoning sometimes of the most profound and fatal kind. The same experiments made on animals living on an ordinary diet show that the excess of the ' poisonous ' food is harmless. For example, certain preparations of irradiated ergosterol given to rats which are being fed on a synthetic diet act as a poison, but if the rats are fed on bread and milk the effect of the ergosterol is negligible. In real life we do not live on a completely synthetic diet ; nearly everyone takes some if not an abundance of fresh food, so the practical value of this type of experiment may be over-estimated, though it is of considerable academical interest.

Civilisation has brought bad sanitation in houses, and even our windows may be depriving us of fresh air and filtering out certain rays of light, bringing its attendant tuberculosis—for tuberculosis is a disease of houses. Science is now engaged in endeavouring to remedy the evil effects which it has produced.

I have endeavoured to show that all precise knowledge in therapeutics is based upon controlled experiments on animals or man, and that the elucidation of the action of medicaments by the methods and data of experimental physiology is one of the most important steps taken to place medicine on a scientific basis. How important this is may be gauged from the fact that all fundamental advances in treatment in the last thirty years have originated directly or indirectly from experiments on animals. There can be no doubt that the future of therapeutics, and therefore of medicine as a whole, is intimately connected with physiology.

Britain for fifty years has every reason to be proud of her progress and achievements in physiology ; it is acknowledged that she can show records second to none and that her savants have included some of the world's greatest investigators. It remains for us to hope that in the future she may attain equal success in the associated sciences directly concerned with the relief of suffering and cure of disease.

News and Views.

IN staging joint discussions upon various subjects of general interest, the British Association performs one of the most useful of its public functions. Scientific workers of different schools and training meet, as they seldom do, to focus their peculiar outlooks upon a particular problem; the public benefits by hearing at first hand the latest developments of scientific thought or discovery, and can scarcely but be impressed by divergences of opinion which suggest that science, still in process of development, abhors dogma and finality. The discussion on "The Nature of Life", held at Cape Town on July 25, was more than usually interesting, since it indicated a swing of the pendulum towards the vitalistic view of the nature of life. According to the Cape Town correspondent of the *Times*, General J. C. Smuts, in opening the discussion, developed his theory of 'holism', which he regards as avoiding the difficulties of both the vitalistic and mechanistic theories. Life is neither a substance nor a force; it is a structure, a new emergent structure based on pre-existent physical structures. Evolution from the most primordial forms of matter to the highest forms of mind is a continuous process, and this process is characterised at one end by physical structures with a minimum of functional structure, and at the other end by functional structures with a minimum of physical structure, and in between by a transition area of combined physical and functional structures. The first is called matter, the second mind, and the area of mixed structures, life.

LIFE-STRUCTURES or patterns, according to General Smuts, have the characters of wholes, which are not mechanical aggregates, but in which each part influences and moulds every other part. In a whole, the parts are really members, and the whole itself appears to play a centralising, unifying, and co-ordinating rôle. Dr. J. S. Haldane in general agreed with General Smuts's rejection of orthodox vitalism and mechanism, and accepted the holistic view of life as a unity which maintains and asserts itself in an environment which is part of its whole. Prof. Wildon Carr stood for the vitalistic outlook, and suggested that Smuts's holism is but another name for entelechy, and that the reality of life is activity of an essentially individual and purposive nature distinct from mechanical activity. Prof. L. Hogben said that he is not prepared to believe anything not amenable to experiment; Prof. A. S. Eddington pointed out that the essential requirements of holism are not radically inconsistent with the mechanistic hypothesis; and Prof. G. Barger made striking testimony to the failure of synthetic chemistry to build up a living cell, pointing out at the same time that although the mechanistic view is difficult to accept, resort to other hypotheses seems to be treachery to science.

ON July 23 the Institution of Professional Civil Servants gave evidence before the Treasury Committee, presided over by Sir Harold Carpenter, which is examining the method of recruitment and conditions of service of the civilian scientific and technical officers employed in Government Departments. At the request of the Committee the Institution had previously prepared a preliminary statement of evidence indicative of its general policy in regard to the matters which the Committee is charged to examine. The Institution's witnesses were led by its president, Sir Richard Redmayne, who was supported by Messrs. S. H. Bales, T. Smith, R. A. Watson Watt, and C. L. Leese. As the Institution is representative of all classes of scientific workers employed by the State in the departments under consideration by the Committee and has acted in consultation with the Association of Scientific Workers, its views upon the organisation of the scientific departments and the conditions upon which the staffs should be employed are worthy of full consideration. The Institution submitted proposals for the co-ordination of all branches of scientific research and experiment in a unified State scientific service. Such a service would involve a common system of recruitment, promotion, and conditions of appointment, and uniform scales of salary. The Institution also emphasised the need for appropriate salary scales and status for scientific officers in order to attract suitably qualified candidates. The careers offered to the scientific staffs should be equal to those offered to their professional and administrative colleagues.

THE Institution submitted specific proposals for common grading and salary scales for a scientific service which in its view could be applied to scientific organisations as at present constituted. It considered that the basic grade should normally be recruited from candidates between the ages of 21 and 24 years who possess an honours degree of a British university or its equivalent. Confirmation in the grade should be subject to the issue of a certificate of competence to perform the full duties of the grade, and such certificate should only be issued after a period of two years of strict probation. The Institution has followed the precedent established in the museums, Royal Botanic Gardens, Kew, and the Patent Office, in submitting a long scale for the basic grade in order that men who perform good service but do not possess such exceptional ability as to obtain promotion quickly shall be in a position to educate their children appropriately and to retire on an adequate pension. The Institution considers that provision for special promotion should be made for officers of exceptional ability. The Institution also dealt with the pay at present attaching to the highest posts in the scientific departments, which it considers entirely inappropriate to the status and responsibilities of their occupants.

THE sixty-eighth annual meeting of the Devonshire Association and the summer meeting of the Newcomen Society were held together at Dartmouth on July 23–26. While both societies carried out their own usual programmes of visits, etc., they joined together to commemorate the bicentenary of the death of the great inventor, Thomas Newcomen, who was born at Dartmouth in 1663 and died in London on Aug. 5, 1729. In the absence of the Mayor of Dartmouth through illness, the members of the Societies

were officially welcomed by Alderman Pillar on behalf of the Corporation of Dartmouth, after which a eulogy on the work of Newcomen was pronounced in the public gardens at the site of the Newcomen memorial by Mr. L. St. L. Pendred, president of the Newcomen Society. Speaking of Newcomen as a man who had brought fame to his town, his county, and his country, and had given the whole world the art of converting fuel into useful power for the benefit and convenience of humanity, Mr. Pendred referred to the difficulty of visualising the conditions with which Newcomen had to contend. Acquainted with the needs of the mines of Cornwall and Devon, which were being killed by the influx of water with which the antique pumping plant of the day was unable to cope, it was Newcomen's glory that he, and he alone, saw the means of meeting the needs and that he produced a design so perfect in its simplicity that for many a long day no radical improvement in it was effected and no other engine appeared in opposition to it. Knowing little of the man himself, yet we may suspect that he had some of the "Divine insanity of noble minds that never falters or abates, but labours, and endures, and waits, till all that it foresees it finds, or what it cannot find, creates".

THE last of the joint meetings was held in the Subscription Rooms at Dartmouth on July 25 to hear a lecture on "Thomas Newcomen—Two Hundred Years of Steam Power", by Eng. Capt. E. C. Smith. Capt. Smith said that though the steam machinery of to-day is the outcome of the work of hundreds of inventors, engineers, and men of science, there are four great landmarks in its history. The first of these is the introduction of the atmospheric steam engine by Newcomen, the second is connected with the epoch-making discoveries and inventions of Watt, the third is the adoption of the compound engine for ships, which we owe to John Elder, and the last is the invention of the steam turbine by Sir Charles Parsons. Historians often fail to realise the importance of the work of Newcomen, who began building engines sixty years before Watt. Watt's great improvements were made between 1765 and 1785, after which came the application of steam to transport on land and sea. Watt had nothing to do with this. The steam engine itself and the locomotive were purely British inventions, but the steamboat was largely due to work in America. By 1840 the total horse-power of the world's steam engines was about 2,000,000; by 1880 it was about 28,000,000; to-day it runs into hundreds of millions, and there seems no adequate reason to think that the steam engine will lose its place as the most important prime mover. Looking back to the days of its original introduction, one can say that Newcomen stood in relation to Watt very much as Trevithick stood in relation to Stephenson: Watt and Stephenson were the great improvers, Newcomen and Trevithick the original pioneers.

IMMEDIATE success has attended negotiations between the Australian Council for Scientific and Industrial Research and the University of Adelaide for the establishment of a Division of Soils Research for the Commonwealth. The Council recently invited the University to co-operate with it in this project, the broad division of responsibilities being that the latter should provide the required laboratories in the grounds of the Waite Agricultural Research Institute, and the former should provide equipment, staff, and maintenance and generally conduct the work of the Division. Within three weeks the University was able to announce that through the generosity of Mr. Harold Darling, acting on behalf of his family, which has for a long time been intimately associated with South Australian agriculture, the sum of £10,000 had been made available for the erection of the necessary laboratories. It is understood that Prof. J. A. Prescott, while still retaining his chair of agricultural chemistry in the University, will be the chief officer of the new Division. He has for some time been adviser on soils problems to the Council for Scientific and Industrial Research, and under his direction much useful work has been done on the soils of some of the irrigation areas. The new move will make possible a considerable extension of activity which, through the Imperial Bureau of Soil Science at Rothamsted, should ultimately benefit many other parts of the Empire.

IN connexion with Mr. Field's suggestion, referred to in our issue of July 27, p. 156, that some of the early peoples of North Arabia may have moved into the Nile Valley, we may refer to a letter from Mr. Guy Brunton which appeared in the *Times* of July 18, in which he gives extracts from a report presented to the Trustees of the British Museum, describing further excavations in Egypt bearing upon the origin and affinities of the Badarian culture. Some doubt has been expressed as to the early date of this culture, but in the past season a widespread Badarian settlement deposit was found into which were sunk many graves clearly subsequent and typically early pre-dynastic (Amratian). The relation between Badarian and Amratian was clearly indicated by the discovery of intermediate types of pottery. An Amratian flint knife 17 inches long is perhaps the longest known. An important addition to our knowledge of the earliest predynastic civilisation has been made in the confirmation of the early date of the culture to which the name Tasian has been given. This culture differs from the Badarian; its pottery, while akin to the Badarian, is distinct and thought to be of earlier date. This is now confirmed by the investigations of Dr. Sami Gabra near Deir Tasa, where an undisturbed grave was found to contain a typical pot and two stone celts. This people apparently also used incised beaker-shaped vases of black pottery. Three skulls have been found in good condition. They differ in type from Badarian, being rounder headed, with squarish faces and heavy square jaws.

IN the same issue of the *Times* is a further contribution to Egyptology, which is also of interest to Biblical students. Dr. A. M. Blackman, in a lecture at Oxford, has suggested that the Papyrus Salt may refer to Moses. An incident described in that papyrus states that the punishment inflicted upon a workman for his misdemeanours by a vizir was revoked by 'Mose'. Apparently he was influential enough to secure the deposition of the vizir, though no title is given him and

no mention is made of any official position held by him. Dr. Blackman suggests that this casual introduction of his name may point to the fact that he was well known as a redresser of grievances interested in the workman class as we know Moses to have been. If this highly speculative suggestion could be supported, it would be of no little interest. It has, in addition, an important bearing upon another point. If the identification were accepted, it would place Moses' sojourn in Midian as during the last years of Sethos II. At the death of this Pharoah five troubled years followed which would have afforded a favourable opportunity for the Exodus. This would give a date for that event at most fifteen years later than the death of Meneptah, in whose reign it is placed by generally accepted chronology, but whose strong character is scarcely consistent with the course of events of the Biblical narrative.

According to the British Rainfall Organisation, Meteorological Office, Air Ministry, the total rainfall over Great Britain for the six months, January to June 1929, was less than 70 per cent of the average for the same period almost everywhere, the only important exceptions being the counties of Devon, Cornwall, and Pembroke, parts of the south-western isles of Scotland and of an adjoining strip on the mainland, a narrow belt along the east coast of Scotland, an area in north-east Yorkshire, and a part of Sussex and the Isle of Wight. In spite of a June which was generally wet in Scotland, percentage values of less than 50 per cent for the six months were recorded in Ross and Cromarty. Another area of less than 50 per cent included a part of south Yorkshire and the northern portions of Derbyshire and Nottinghamshire. At Camden Square, London, the total fall for the six months was 52 per cent of the average. In Ireland the fall for the six months was generally in excess of 50 per cent. Less than 60 per cent occurred along the north-west coast and around the mouth of the Shannon. More than 80 per cent occurred in places on the east coast, while the highest percentage value for the six months was 116 per cent at Waterford. In most parts of England, Wales, and Ireland, June was a dry or very dry month. Only about 40 per cent of the June average was recorded in the southern Pennine area, in the eastern parts of Lincolnshire and Norfolk, in a large area including much of Cambridge, Bedford, Hertford, and Essex, and round the mouth of the Shannon. More than 180 per cent of the average June fall was measured in the extreme north of Scotland and more than 130 per cent in the extreme north of Ireland. About 150 per cent of the average amount fell in south-west Cornwall. At Camden Square, London, the June fall was 64 per cent of the average.

Several specimens of the Nkosi Island situtunga (*Limnotragus spekei sylvestris*), recently described by Colonel R. Meinertzhagen, have been received in the Department of Zoology of the British Museum (Natural History) from Captain C. R. S. Pitman, Game Warden of Uganda. Nkosi Island, the southernmost of the Sesse Group, in the Victoria Nyanza, is an island covered with dense, dry forest, and the situtungas, which are usually swamp-dwelling antelopes, have assumed more terrestrial habits. Colonel Meinertzhagen estimated that in 1926 there must have been at least two hundred of these animals existing on Nkosi Island. The Department of Entomology of the Museum has received from Mr. F. W. Urich, Port of Spain, Trinidad, six examples of *Pantophthalmus tabaninus* Thunb., a large two-winged fly, specimens of which sometimes measure as much as two inches in length. *Pantophthalmus*, which occurs in the West Indies and other parts of tropical America, is the largest of all Diptera; notwithstanding its formidable appearance, however, it is quite harmless and is incapable of biting. The larvæ have the remarkable habit, unique among Diptera, of boring in the solid wood of living trees, in which they gouge out clean-cut, nearly horizontal tunnels, and feed upon the exuding sap. Mr. Frank H. Taylor has presented a green cicada (*Cystosoma saundersi* Westw.), taken by him at Eungella, Queensland. The song of this insect, which in New South Wales and Queensland occurs locally in vast numbers, is heard in hot and sultry weather before a thunder-storm. It is said to be unlike the shriller and harsher notes uttered by the common cicada, and to resemble the sound of a loud, deep, and guttural 'R', continued incessantly, with vibrations. The Trustees have accepted for the Department of Botany the bequest by the late Mr. Arthur Bennett of his herbarium of British pondweeds. Mr. Bennett made a lifelong study of the genus *Potamogeton*, and the value of his herbarium is much enhanced by the inclusion of numerous notes and correspondence relating to the specimens.

At the eighth annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 26, the chairman of the Council, Dr. E. S. Beaven, reviewed in turn the principal activities of the Institute in the past year. Two important branches of the work, the Official Seed Testing Station, and the Wart Disease of Potatoes Immunity Trials, are delegated to the Institute by the Ministry of Agriculture, and these functions are supplemented by cognate investigations into germination problems, potato virus diseases, and the yield and maturity of potato varieties. The Potato Synonym Committee, of which Dr. Salaman is the chairman, has reported a substantial improvement in the nomenclature of potatoes; the Council hopes to win the co-operation of seedsmen in extending this work to cereals. Dr. Beaven referred to the encouragement offered in the last century by the Royal Agricultural Society to plant-breeders and, after tracing the relationship between animal and plant breeding and the influence of Mendel's work, pointed out that field trials of the kind undertaken by the Institute would be needed for many years. The difficulty of the task and the value of the results were illustrated by the series of barley trials completed in the past year. Two varieties raised by systematic methods of plant breeding were shown to be generally and significantly more profitable to farmers than any others, and records collected

independently by the Official Seed Testing Station and the Essex County Farmers Union not only confirmed this conclusion but also showed that these two varieties are now grown more widely than any others. The study by competent critics of these and the similar results now being obtained at the Institute should win for it the support of agriculturists.

WE learn from the *Times* of July 23 that at the suggestion of Dr. R. J. Renison, rector of Christ Church, Vancouver, the Royal Empire Society is having a plaque made in England to be placed in Vancouver Cathedral to commemorate the work of Captain Cook in that part of the world. Records show that it was in 1778 Cook sailed up the west coast of North America. He struck the coast at Lat. 44° 55′ N. on Mar. 7, and he "proceeded to make an almost continuous survey of the coast" up to and beyond Bering Straits as far as Lat. 70° 41′ N., where he was barred by the ice. He named the farthest visible point, Icy Cape; he also discovered and named Nootka Sound, Prince William's Sound, and Cape Prince of Wales; and he penetrated Cook's Inlet. His work is believed to have inspired that of Vancouver in 1792, when the latter circumnavigated the island that now bears his name. The memorial is to be unveiled in September during the visit of Sir John Sandeman Allen, chairman of the Royal Empire Society.

MR. F. W. SKINNER, in *Engineering* for July 19, gives an account of the difficult, but finally successful work, of righting one of the large reinforced concrete caissons which had capsized on July 27, 1927, while being sunk into position for one of the piers of the Poughkeepsie Suspension Bridge, N.Y. The caisson, 136 ft. long, 60 ft. wide, 104 ft. high, when it capsized, had a weight submerged of nearly 13,000 tons, equivalent to about 19,000 tons in air. Owing to the great depth of water, strong tidal currents, formation of ice, and the traffic in the river, the work of righting proved an arduous matter, and it was not until Oct. 8, 1928, that the caisson was finally in position again. The methods employed included the weighting of the higher side of the caisson, lifting the lower side by means of steel pontoons from which the water had been pumped, and pulling by tackles anchored in the river bed. It was estimated that forces approximating to 100,000 ft.-tons were brought to bear on the caisson as against the adverse moment of 40,000 ft.-tons. After righting, the sinking operations were resumed and the pier completed on May 17, 1929.

WATCHING the modern passenger-carrying aeroplane in the air, it is difficult to realise that a machine built just over twenty years ago is of sufficient interest and importance to justify a place in the Science Museum, Kensington. So fast has been the progress of aeroplane construction, however, that the little monoplane in which M. Louis Blériot crossed the English Channel on July 25, 1909, is now a historic relic. The occasion was commemorated on Saturday last, when M. Blériot crossed the Channel in one of his latest machines, a twin-engine monoplane of about 1000 h.p. The crossing occupied 12 min., as against the 33 min. taken in the flimsy little machine he used twenty years ago. M. Blériot landed at Swingate Aerodrome, Dover, and went by motor-car to North Foreland Meadow, where there is a commemoration stone to mark his landing there in 1909. He was welcomed by the Mayor of Dover and Sir Sefton Brancker, Director of Civil Aviation in Great Britain, and afterwards proceeded by air to London. The same evening, M. and Mme. Blériot were the guests of honour at a dinner, presided over by Lord Thomson, Secretary of State for Air, to celebrate the Seventh International Aero Exhibition being held at Olympia.

A CONSIDERABLE earthquake was recorded at Kew Observatory on July 23. The first impulse reached the Observatory at 8 hr. 47 min. 5 sec. Greenwich Mean Time. The seismograms indicate that the epicentre was close to the north coast of Ireland.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in mechanical engineering at the Swansea Municipal Technical College—The Director of Education, Education Office, Dynevor Place, Swansea (Aug. 10). Inspectors for the purposes of the Diseases of Animals Acts, 1894–1925, under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall-place, S.W.1. (Aug. 12). A technical officer, at the Royal Aircraft Establishment, for writing descriptive matter and instructional handbooks on wireless and electrical apparatus—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Aug. 13). An assistant in the dairy bacteriology research division of the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (Aug. 14). A taxidermist and an assistant librarian in the Faculty of Science of the Egyptian University, Cairo—The Director of the Egyptian Education Office, 39 Victoria Street, S.W.1 (Aug. 15). A resident lecturer in geography at the Caerleon Training College for Men—C. Dauncey, County Hall, Newport, Mon. (Aug. 21). An assistant lecturer in physics at the Bradford Technical College—The Principal, Technical College, Bradford (Aug. 23). A chemist with experience in research on yeast problems for research work in industrial microbiological chemistry—The Research Manager, Imperial Chemical Industries, Ltd., Technical Department (Nobel Section), Stevenston, Ayrshire. A lecturer in physics at the Memorial University College, St. John's, Newfoundland—S. T. Harrington, Woodfield, Malvern Wells, Worcs. Laboratory assistants at the Royal Arsenal, Woolwich—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18. A computer under the Government of Tanganyika Territory, for the Survey Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1405). A junior assistant in the department of the War Department Chemist—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18. A lecturer in agricultural chemistry in the University of Reading—The Registrar, The University, Reading.

Research Items.

Salmon Fishery in California.—The development of the use of water-power in Great Britain and its preliminary, the impounding of lakes and damming of rivers, are bound ultimately to have an adverse effect on the salmon productivity of the country, and that probably in spite of the best safeguards which can be agreed upon. The lesson of the Sacramento and San Joaquin Rivers in California, the first rivers there to to be fished for salmon by white men, is a plain one. Since 1874 the fishery has produced 205 millions of pounds of salmon (says *California Fish and Game* for January), and now, in an endeavour to keep up the stock, as many as 100,000,000 young salmon from hatcheries have been planted in a single year. Overfishing is apparently one cause of the decline, but a factor, scarcely less important, is the cutting off of the spawning grounds by dams. An important investigation of the spawning beds has just been completed, and this has necessitated observations of obstructions in the streams and of the workings of fish-ladders and screens. The survey has determined that, as near as can be calculated, there were, in 1928, 510 lineal miles of stream in which salmon might spawn, as compared with the 6000 miles before the dams were constructed. It is estimated that 80 per cent of the spawning grounds in the Sacramento and San Joaquin river systems have been cut off by the obstructions of dams, both power and irrigation. The salmon fishery in California is now at the point when something must be done, and at once, in order that it may be preserved for future generations to enjoy.

An Amphibious Centipede from India.—At the Indian Science Congress, B. Bonnell described the finding of a Geophilid in loose soft mud in the mouth of the Coum River, Madras. The specimens were obtained in July 1928 when collecting polychæte worms, *Marphysa* and *Lycastis*, in the bed of the river in brackish water. It was found that the centipedes could withstand immersion in water for nearly twenty-four hours. The other amphibious centipedes recorded are *Linotenia maritima* and *Schendyla submarina* on the shores of the Mediterranean and on the Atlantic coast of Europe, and *Pectiniunguis americanus* under seaweed, driftwood, etc., on the shores of the Gulf of Mexico. The author suggests that amphibious centipedes may be more widely distributed than these records indicate.

The Mammals of Ceylon.—Since a provisional list of the mammals of Ceylon was published in 1923, many new forms have been discovered in the island, and new facts have been brought to light regarding distribution. Accordingly W. W. A. Phillips contributes a new check list, in which the names, scientific and native, and the range of each species and subspecies are recorded (*Spolia Zeylanica*, vol. 15, p. 119; 1929). The mammals have increased in number to ninety-eight species and sub-species, and even the bare list brings out some interesting features. Ceylon may be broadly divided into three climatic zones, the low-country dry zone, comprising the northern half of the island and possessing a fauna closely resembling that of the Indian mainland; a low-country wet zone; and a central hill zone. Each zone has a fauna differing in many respects from that of each other zone, and in many cases the forms found in any zone are peculiar to it and are not found in the remainder of the island.

Rhizopoda of the North Sea and Baltic.—Dr. L. Rhumbler (Die Tierwelt der Nord- und Ostsee. Lieferung 13, Teil II. a, "Amœbozoa et Reticulosa)" describes the Amœbozoa and the Foraminifera of these regions. Although marine amœbæ are very common they are still little known. It seems extraordinary that only one species has been described which was actually living in the North Sea, and this one is a parasite in the diatom *Biddulphia sinensis*. Free-living amœbæ have been found by Rhumbler and Gruber in aquaria filled with North Sea water—*Amœba comminuens* and *A. crystallina*—and in aquaria filled with Baltic water from Kiel six species, including *A. crystallina*, have been described. Three of these are well known in fresh water. Many of the small amœba-like organisms found in the sea are most probably phases in the life of certain Foraminifera. In the sub-order Testacea only five species are known in the sea water and these mostly from aquaria. Amongst them is the interesting *Trichosphaerium sieboldii*, which has an alternation of spore formation with a gamete-forming phase. On the other hand, the order Reticulosa is rich in species. The Foraminifera have always been specially studied. They are easily collected and the shells are varied and beautiful. Two species of the sub-order Nuda are included, and a member of the genus *Labyrinthula* not yet identified has been found commonly in the sea-water aquaria of Heligoland. All the rest belong to the true Foraminifera. There are useful keys for the identification of species, of which there are about 200 in the area, chiefly from the North Sea and western Baltic, the eastern part of the Baltic being poor in these little organisms.

Possible Molluscan Hosts for Cercariæ in the Shan States.—The occurrence of schistosomiasis in coolies from Yunnan at a hospital in the Northern Shan States, and the fear of the possibility of the spread of the disease from China into Burma, led to a survey of the molluscs of the Northern Shan States with the view of ascertaining if any known carriers occurred in the region. This survey was conducted in November 1926–January 1927, under the direction of Dr. H. S. Rao, of the Zoological Survey of India, and his report on "The Aquatic and Amphibious Molluscs of the Northern Shan States, Burma," has now been published (*Rec. Indian Mus.*, vol. 30, pt. 4). It is a very careful and thorough systematic account, admirably illustrated, of the 48 species of mollusca (including 29 forms, races, and varieties) met with, of which one genus, *Ekadanta*, and 21 species and forms of gastropods, are described as new. So far as the occurrence of schistosome cercariæ and of the known carrier-snails was concerned, the results of the survey were negative, but the adaptive, if not the specific host of *S. japonicum* occurs in the Shan States, and the constant stream of Chinese coolies which comes in from adjacent infected Chinese provinces is more likely than not to carry with it the insidious parasite. A thorough survey of the frontier districts at all seasons hence seems to be desirable.

Tropisms and Sense Organs of Lepidoptera.—Under the above title, Dr. N. E. McIndoo, of the U.S. Bureau of Entomology, has written an excellent illustrated article which appears as Smithsonian Miscellaneous Collections, vol. 81, No. 10 (1929). It is well known that many phases of insect behaviour are still unexplained and, in turn, behaviour is largely the result of tropic responses. In this paper Dr. McIndoo brings together the available information on the tropisms and sense organs of Lepidoptera, and includes the results of his own special studies on the

codling moth. Certain tests carried out with larvæ of this insect indicated that, when in the first instar, their eyes are photopositive and they search freely for food, but they are apparently not aided by their senses until within a few millimetres of the food. Larvæ in the fifth instar sometimes acted indifferently to light, but generally were weakly photonegative. Older larvæ when ready to spin their cocoons are strongly photonegative: they react positively to gravity and to thigmotropic stimuli, whereas the younger larvæ behaved in an opposite manner in relation to these three types of stimuli. Change in tropisms, therefore, brings about great differences of behaviour. The author believes that those sensory structures, termed by him 'olfactory pores', which are widely scattered on the bodies and appendages of both the moths and their larvae, are receptors of smell.

Proteolytic Enzymes in Green Malt.—The attempt to identify the proteolytic enzymes of plants with systems like the tryptic and peptic types of animals has been criticised by C. K. Mill and K. Linderstrøm-Lang (*Compt. Rend. Lab. Carlsberg.*, **17**, 1-14; 1929), who prefer to characterise the plant enzymes by the nature of the substances they affect. In green malt, for example, they distinguish only two enzymes of the proteolytic type, a protease (*p*H optimum 4·3) and a peptidase (*p*H optimum 7·6-7·9), the action of which on dipeptides is greatly inhibited by phosphates.

Ocean Surface-Water Temperatures.—Means of accurate and quick recording of surface temperatures of the ocean are described in a paper by Sir Frederic Stupart and Messrs J. Patterson and H. G. Smith in *Bulletin* No. 68 of the National Research Council (Washington, D.C.: National Academy of Sciences). The most effective instrument was found to be a mercury-in-steel thermograph in which the bulb was heavily plated with copper and inserted in the intake of the steamer's condenser. The recording part is of the usual thermograph pattern and is fixed between two ribs of the ship. The trace never showed any signs of vibration. The apparatus was tried on North Pacific and equatorial steamer routes. So far, the most numerous data have been obtained from the North Pacific. A study has been made of departures from normal of North Pacific water temperature, with the view of discovering if any correlation can be found between variations in water temperature and the weather of western Canada. A fairly definite correlation has been established, especially in winter, between the temperature of the water and the intensity of the Aleutian atmospheric low pressure area. When the temperature gradient is large the pressure is low, and this means increased oceanic winds with higher temperatures on the Canadian seaboard. However, when the temperature gradient of the water has its normal maximum in summer, the Aleutian low is not marked, so that other factors must be involved.

Superconductivity of Thorium.—The issue of *Die Naturwissenschaften* for May 24 contains a short note from Prof. W. Meissner, in which he states that he has succeeded in obtaining metallic thorium in the superconducting state. The specimen experimented upon was a single crystal, 12 mm. long and 3 mm. thick. When cooled in liquid helium its electrical resistance was at first a little less than two per cent of its resistance at 0° C. The transition took place at about 1·4° absolute, and at 1·3° absolute the resistance had fallen to less than 10^{-4} of its value at 0° C. Thorium becomes a superconductor at a lower temperature than any other metal which it has yet been found possible to obtain in this peculiar condition, the lowest transition temperature previously recorded being 2·1° absolute for the gold-bismuth eutectic. Prof. Meissner suggests, however, that silicon may become superconducting at some temperature below 1·2° absolute.

The Carbon Molecule.—Dr. R. C. Johnson and Mr. R. K. Asundi have contributed an interesting paper to the July number of the *Proceedings of the Royal Society* on the diatomic carbon molecule which exists in the discharge tube. Two years ago, before the guidance afforded by recent developments of the theory of band spectra had become available, Dr. Johnson had suggested, in connexion with an analysis of the fine structure of the well-known Swan bands, that these arose from a molecule with the same empirical formula as acetylene (C_2H_2). Since then, evidence, which is largely summarised in the present paper, has been accumulating that carbon (C_2) and not 'acetylene' is the true emitter, and this view is now endorsed. In addition, it has been found possible to extend the previously described so-called high-pressure bands of carbon into the ultra-violet and infra-red, and it has now been shown that both these and the Swan bands represent transitions to a common final state. Dr. Johnson also discusses the discharge conditions under which C_2 molecules are likely to be found, and states very clearly and with some extension Mulliken's theory of the structure of this form of carbon.

Aggregation of Small Particles.—A very remarkable instance of the aggregation of small particles has been described by H. S. Patterson, R. Whytlaw-Gray, and W. Cawood in their paper on the structure and electrification of smoke particles which appears in the July issue of the *Proceedings of the Royal Society*. An azo-dye, *m*-xylene-azo-β-naphthol, was volatilised on to a slide. At first a mixture of red supercooled spherical droplets and closely packed crystalline aggregates was formed. Then, on standing, some of the crystalline particles proceeded to develop hair-like tails which were both long and extremely tenuous. As the tail grew, the crystal aggregate diminished in size, and in addition surrounding droplets evaporated, until in the final stages of the rearrangement there were in many cases only the hairs left. The latter were sometimes as long as 0·15 mm., and when a crystalline head still remained, the tail dwindled away from a thickness of the order of 10^{-4} cm. near the head to probably less than 10^{-5} cm. at the other end. No substance other than this particular azo-dye has yet been found to show the effect on any comparable scale. Two good microphotographs of the hairs are reproduced in the paper, and in both the hairs would, in absence of further description, probably be taken to be dirt on the slides.

Dust in New York City Air.—An article by Dr. E. E. Free in the *New York Times* of June 30 describes tests made of the air in New York, in April and May last, to determine the degree of smoke pollution, and the number, size, and character of dust and soot particles in the air at different heights above the street level. The instrument used was the Owens' dust counter. Ultra-violet radiation was examined by a spectroscope. The greatest number of particles counted in any sample was 910,000, the lowest 250,000 per cub. ft. It is stated that rain greatly decreases the dust in the air and that the chief source of dust appears to be domestic fires. The heaviest rain never reduces the dust content of the air to zero, and a heavy downpour was less efficient as a dust remover than a thin, long-continued drizzle. The quantity of dust at any place

is governed chiefly by wind direction. An important fact brought out was the decrease of dustiness above street level, so that at about 200 ft. up the dust was reduced by 25-50 per cent. The New York dust was found to consist chiefly of grains of soot, averaging 1/20,000 of an inch diameter. It is assumed that these are removed from the air by settlement after aggregation into larger masses. This is not supported by evidence, and the removal of the particles from the city by the wind does not appear to have been taken fully into account. A discrepancy is indicated between the results of these tests and others made by the Carrier Engineering Corporation. The latter indicated some 2000 tons of solid matter in the air above the city, while the tests described indicated about 4 or 5 tons. It is stated that, from the middle of October to about the middle of April, no measurable trace of ultra-violet radiation reaches even the tops of the buildings in mid-town New York.

A New Valve Effect.—An important new effect in thermionic tubes is described by K. H. Kingdon and E. E. Charlton in the June number of the *Physical Review* (p. 998). It had been found that hot filament tubes containing a trace of cæsium vapour could act as very sensitive detectors of radio signals under certain conditions, and a more detailed investigation showed that this was not being brought about through curvature of the characteristic curves. It was ultimately found that what was apparently occurring was that the cæsium was being ionised at the surface of the filament and then accumulating in the positively charged state near the region of minimum potential which surrounds this electrode, where it modified the space-charges in such a way as to increase the electron current to the grid and anode. The ions have a natural period of vibration about the surface of minimum potential, and when acted upon by an alternating electromotive force of the same frequency, are set into resonant vibration; being then more diffusely spaced, they exert less control on the electron current, which is thus reduced. The calculated and observed periods of the ions are of the same order of magnitude. In a further note by K. H. Kingdon (p. 1075) it is mentioned that a similar effect can be produced by ions generated by electronic impact between the grid and anode, and that their response is sufficiently selective to permit of the resolution of separate rectification peaks for each of the isotopes of neon and argon.

Determination of the Chemical Constituents of Petroleum.—The Bureau of Standards of the U.S.A. is co-operating with the American Petroleum Institute in an investigation for the separation and identification of the constituents of petroleum, and the apparatus and methods in use are described by E. W. Washburn, J. H. Bruun, and M. M. Hicks in the March issue of the Bureau of Standards publication, *Journal of Research*. Details are given of a number of stills of various types, and an interesting part of the paper deals with molecular stills, first used by Brönsted and Hevesy for separating the isotopes of mercury. An apparatus for the combustion analysis of hydrocarbons up to C_{100} is also described, the accuracy of determination of both carbon and hydrogen being about $\pm 0{\cdot}05$ per cent. It has been found possible to carry out the distillation of petroleum at high temperatures without cracking, provided that all air is excluded. A note is included in the paper directing attention to the fact that the danger of poisoning from mercury spilled in laboratories is probably very small owing to the rapid contamination of the mercury surface with oil or grease.

Locomotive Performance.—Mr. E. C. Poultney, in the *Engineer* for July 5 and 12, discusses the comparative efficiencies of two American locomotives—one of the Pacific 4-6-2 type and another of the Atlantic 4-4-2 type—working under varying conditions of speed. In the same journal in 1924 Mr. Poultney dealt with the boiler efficiency and cylinder efficiency of these engines, but in the present articles he treats of the complete locomotive, taking into consideration the combined efficiency of the unit as a whole. He first considers the mechanical efficiency or the power absorbed by the engine in moving its working parts; he shows how fuel consumption is related to power, and gives the fuel and steam rates per dynamometer horse-power and their relation to speed in miles per hour. Other sections of his articles are devoted to superheat and thermal efficiency, boiler efficiency, cylinder efficiency, and, finally, locomotive performance. Each section is illustrated by curves for the two engines, and in a table he gives some interesting figures of the Pacific engine working at varying speeds with a constant cut-off and at constant speed with varying cut-off. In the first instance, the engine was run at speeds rising from 120 r.p.m. to 320 r.p.m., the I.H.P. ranging from 972 to 2290; the efficiency at the same time fluctuating between 5·96 per cent and 7·61 per cent; in the second instance the engine speed was kept at 240 r.p.m., but the cylinder cut-off altered from 20 per cent to 50 per cent. Here the lowest locomotive efficiency was 4·56 per cent and the highest 6 per cent. Comparing the two locomotives when being used under the best conditions for economy in the use of the heat units available in the fuel fired, the Pacific engine showed a decided superiority over the Atlantic engine.

Rating Electric Lamps.—During the last twenty years considerable progress has been made in the standardisation of electric lamps. Formerly it was the custom to buy lamps rated as 8, 16, 32 . . . candle-power. We now buy lamps according to the electric power they require; for example, 10, 20, 30 . . . watt lamps. It may be argued that what a consumer wants to buy is a device to give light and not a device which takes a specified amount of power. This is recognised by the manufacturer. It is much easier to measure electric power than it is to measure candle-power, and the ratio of the two in different types of lamps is known approximately and is often given. It is certainly much easier to rate lamps by the power they take and it can be done more accurately. We think, however, that the approximate candle-power should also be marked on all lamps. Naturally, if the rated watts proceed by decimals, the rated candle-powers do not proceed by decimals, and the differences between them vary according to no simple law. In an official specification published in March last by the U.S. Bureau of Standards, the amounts of the tolerances permitted both from the rated electric power and from the rated light-giving efficiency are given for electric lamps with tungsten filaments. With a 40 watt lamp, for example, the candle-power per watt may vary from 7 per cent below to 7 per cent above the standard efficiency. The corresponding admissible power variation from the standard is 5 per cent. In another official American specification for miniature lamps, issued at the same time by the Bureau of Standards, we find that the average life of miniature tungsten filament lamps for flash-light service varies from 5 to 14 hours, and for automobile service it varies from 100 to 360 hours. The life of a lamp is supposed to be finished when the light it gives has fallen by a definite percentage from its initial value.

Protection from Lightning.

THE desirability of protection from lightning was recognised from the earliest times. The earliest attempts consisted of exorcisms by priests, the wearing of charms, the ringing of church bells, and even the burning of witches. It was not until about 1750, when Franklin proved that a lightning flash was an electrical phenomenon and could be guarded against by suitable conductors, that these superstitions began to die away. Still, it is only of recent years that, mainly owing to the work of Lodge, the true function of these conductors has begun to be understood by physicists. Engineers are now putting into practice what they learn from theory and discover from high voltage experiments. Finality, however, is still far from being attained. We welcome, therefore, the new Code [1] for protection against lightning, which has recently been issued by the U.S. Bureau of Standards and the American Institute of Electrical Engineers.

In this book instructions are first given to guide the conduct of persons during thunderstorms. Then the methods of protecting buildings and miscellaneous property are described, and finally how structures containing inflammable liquids and gases can be safeguarded. In the appendix an account is given of various kinds of 'lightning' discharge and a brief notice of various recent theories.

So far as the rules given for personal conduct during a thunderstorm are concerned, we think they are reasonable. There is no shutting of windows, pulling of blinds, and lighting of candles, customs still adhered to in some places. Neither are nervous people told to go and lie in an empty metal bath, although the advice may be psychologically sound. Lightning fatalities are very rare, and only about ten per cent of them happen to persons who are indoors. All one has to do, therefore, is to stay indoors and keep away from fireplaces, stoves, and other metal objects.

If one is out-of-doors, the following shelters in order of preference are given: (1) Large metal or metal-framed buildings, (2) dwellings having lightning conductors, (3) large buildings or (4) small buildings. If one has to remain out-of-doors, keep away from (1) small sheds and shelters in an exposed position, (2) isolated trees, (3) wire fences, or (4) hilltops and wide open spaces. If one is in the 'wilds', seek shelter in (1) dense woods, (2) a grove of trees, (3) a cave, (4) a depression in the ground, (5) a deep valley or gorge, or (6) the foot of a steep or overhanging cliff. These rules are, of course, not perfect, but their brevity and generality should make them acceptable.

In specifying lightning conductors, we were interested to see that it is apparently immaterial what metal or alloy is used in their construction or what is the shape of their cross section. Instructions are given in the methods used for preventing them from deteriorating. If they are subjected to the direct action of chimney or other corrosive gases, the useful advice is given that they should be protected by a continuous covering of lead not less than one-sixteenth of an inch thick. We are told that the use of glass balls as ornaments on lightning rods is not objectionable. We suppose that this means that the lightning rod is just as efficient when a glass globe is placed on the top of it. We remember being told that during the South African war, British soldiers used to put empty bottles on the top of their tent-poles in the hope that this would prevent their tents being struck by lightning. The methods described of earthing the conductors are quite satisfactory, and no undue stress is laid on the ohmic resistance of the 'earth'.

During the War, several cases occurred of captive balloons and airships being struck by lightning. Fires also were caused by the long sparks which sometimes take place between the airship and the earth at the landing place. These experiences are reflected in the rules. Captive balloons are now earthed through the metal cable and winch by a pipe or tube driven six feet into the ground. Free balloons and airships are provided with an effective earthing wire which is lowered just before landing. It makes contact with a good earth and thus the electrical charges which may have accumulated on them when in the air are conveyed harmlessly to the earth.

In the United States, the protection of valuable or historic trees from lightning by means of conductors is being done on a rapidly increasing scale. In general, a single conductor is run from the highest part of the tree to the earth connexion. If, however, the tree has large branches, conductors are extended to their extremities. Somewhat elaborate arrangements depending on the size of the tree are used for earthing. A shallow network is used to collect the current near the surface of the earth so as to protect the roots of the tree, which experience has shown are as likely to be damaged as the tree itself. It is an excellent plan also to put lightning conductors on trees the neighbourhood of which is frequented by livestock. Full instructions are given for mitigating the dangers arising from wire fencing. Fences are earthed by means of iron posts or, more cheaply, by driving lengths of galvanised iron pipe at least three feet into the ground and attaching it by ties of galvanised wire to the fence. In addition to earthing the fence, its electrical continuity should be broken by breaking the wire at intervals of about a thousand feet and joining up the breaks by insulating material.

Full details are given of excellent methods for protecting structures containing inflammable liquids and gases from lightning. All-steel gas-tight tanks with vents adequately 'flame-proofed' are considered to be completely protected. So also are tanks with floating roofs, which prevent the accumulation of explosive mixtures, provided that there is provision for minimum exposure of the contents.

In an interesting appendix the origin, characteristics, and effects of lightning are described. An ordinary flash of lightning is called streak lightning. In rocket lightning, the growth is so slow that it reminds one of a rocket. In bead lightning we have a string of luminous globes separated by darker intervals. There are other forms such as sheet and globular lightning and St. Elmo's fire.

A brief résumé is given of Simpson's and C. T. R. Wilson's results, and an excellent photograph, taken by a moving camera, is shown, which proves that a flash can be rapidly intermittent. Instructive data taken from U.S. Weather Bureau publications show the frequency of thunderstorms in various places in the United States. A sequel to this code will deal with electrical apparatus and power lines, and it will be of great interest, as there are considerable divergencies in American and Continental practice.

A. R.

[1] Department of Commerce: Bureau of Standards. Miscellaneous Publication, No. 92: Code for Protection against Lightning. Approved April 4, 1929, by the American Standards Association. Pp. xiii+114+2 plates. (Washington, D.C.: Government Printing Office, 1929.) 25 cents.

Studies in Oxidation-Reduction.[1]

THIS bulletin, obtainable for a mere half a dollar, consists of reprints of the masterly series of researches published by W. Mansfield Clark and his associates from 1923 onwards. Twelve pages of supplementary notes have been included. The principal author, well known for his valuable book on "The Determination of Hydrogen Ions", was quick to appreciate that Gillespie's measurements of the electrode potentials induced by bacterial reduction, published in 1920, revealed a method whereby it might be possible to accumulate *quantitative* data concerning oxidation and reduction. The first paper outlines the theoretical aspect of the problem and shows how it is possible to express relative oxidation-reduction intensities in terms of electrode potential. For each system a constant can be found which is a measure of its oxidation-reduction *intensity*, a matter quite apart from the *capacity* of a solution to oxidise or reduce. A series of substances can therefore be arranged, so that when themselves in the half-oxidised or half-reduced state, each one will tend to oxidise one with a more negative constant, and to reduce one with a more positive constant.

The second paper is devoted to a consideration of the theoretical relations between reduction potentials and hydrogen ion concentration. Oxidation or reduction will displace *p*H in one direction or another in accordance with the acidic or basic nature of the group destroyed or created.

The third of the series relates to an experimental study of the electrode potentials of 1-naphthol-2-sulphonic acid indophenol and its reduction product. It includes a valuable description of apparatus and methods.

The fourth deals similarly with the indigo sulphonates, and the fifth with simple indophenols, dibromo substitution products of phenol indophenol and substituted indophenols of the ortho type being studied in the sixth, while the seventh discusses the dichloro substitution products of phenol indophenol.

The eighth is devoted to methylene blue, a substance of great histological and physiological interest, since it is a most useful *intra vitam* stain. The bibliography on methylene blue occupies nineteen pages, with about four hundred and fifty citations, and is probably the most complete in existence.

The ninth is entitled "A Potentiometric and Spectrophotometric Study of Meriquinones of the *p*-Phenylene Diamine and the Benzidine Series". The behaviour of these substances is so complicated, and the tendency to autoxidation is so considerable, that the authors consider it extremely dangerous to draw conclusions from colour reactions with benzidine, *p*-phenylene diamine, and their homologues. In view of the vogue these substances have had as oxidase reagents, the warning should not be forgotten.

The tenth deals with reduction potentials in cell suspensions. Relatively wide spans of potential are covered. Various aspects of the experimental data seem to indicate that cell suspensions are poorly poised with respect to the electromotively active material present at any moment, but that active material is slowly mobilised by cell catalysts from some large reserve. Several of the implications of current theories regarding biological oxidation and reduction are discussed. This discussion and the experimental data lead to the conclusion that the immediate problem is a clearer definition in *experimental* terms of the isolated chemical systems found in the cell.

The supplementary notes supply valuable additions and some trenchant criticism of subsequent work. Attention is directed to the necessity for a clear distinction between "the intensity factor measured in any proper terms but expressed by us in volts, and the capacity factor expressed in chemical equivalents or in faradays". The product is a work term and has nothing whatever to do with kinetics. "Therefore the term reducing *power* (power involves a *time* factor) should never be applied in descriptive text dealing with equilibrium states. The term *reducing ability* is often meant where *reducing power* is used."

The eleventh paper of the series, dealing with toluylene blue, is not included, but some data concerning this compound are included in the supplementary tables.

It cannot be pretended that these papers are anything but difficult reading; the conceptions set forth in them are, however, of fundamental importance; one can search current text-books in vain for any mention of them—though the series started in 1923, and the tenth appeared in 1926. It is to be hoped that all future workers on plant and animal respiration will carry on their researches with a due regard for the theoretical considerations and the exact quantitative data presented by this brilliant American chemist and his collaborators. In its orderly correlation of a large mass of data, in a region which before was in chaos, one is reminded of Loeb's work on "Proteins and the Theory of Colloidal Behaviour".

[1] Treasury Department: United States Public Health Service. Hygienic Laboratory Bulletin No. 151: Studies on Oxidation-Reduction, I-X. By the Staff of the Division of Chemistry. Pp. vi+363. (Washington, D.C.: Government Printing Office, 1928.) 50 cents.

University and Educational Intelligence.

EDINBURGH.—Dr. Thomas W. M. Cameron, of the London School of Hygiene and Tropical Medicine, has been appointed lecturer in helminthology in the Department of Zoology of the University and in the Royal (Dick) Veterinary College. Mr. A. L. Bennett has been appointed lecturer in zoology in the University.

MANCHESTER.—The Council has appointed Mr. N. F. Mott to be lecturer in mathematical physics.

The Grisedale Scholarships for biological research have been increased in value to £200 each, and awards have been made to Dr. Miriam K. Bishop (botany) and to Mr. Ieuan Thomas (zoology).

SIR FRANK HEATH has accepted the invitation of the executive committee to become the secretary of the Universities Bureau of the British Empire. Sir Frank Heath was permanent secretary of the department of Scientific and Industrial Research, and previously principal assistant of the Board of Education for England and Wales in charge of the universities and training colleges branch of the Board.

THE London County Council has awarded Robert Blair fellowships, which carry a grant of £450, to Mr. C. G. Davies, of Gorseinon, Glamorgan, and to Mr. G. L. Riddell, of Muswell Hill, London. Mr. Davies, who is works manager of the Grovesend Steel and Tinplate Company, Gorseinon, will carry out a detailed investigation into modern developments of practice in steel sheet, tinplate, and galvanised sheet manufacture in the United States. Mr. Riddell will study printing and its allied trades in relation to its machinery processes and methods of production in Canada, the United States, and Germany.

FOLLOWING on the representations made in Australia last year on behalf of the Colonial Office by Major R. L. Furse, the Prime Minister has appointed a central committee of advice in connexion with the

making of selections from graduates nominated by the various Australian universities for appointment to the Colonial Service. The chairman is General Sir Brudenell White, and the other members are the Hon. F. W. Eggleston, Dr. J. H. L. Cumpston, Dr. A. C. D. Rivett, Major Keith Officer, and Mr. S. S. Addison (secretary). This move will be appreciated in the Commonwealth, though it is improbable that many candidates will be available for some years for scientific posts in the Colonies, particularly in biological divisions of work.

THE following awards for the year 1929–1930 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company. Fellowships have been renewed to: Mr. C. G. Akhurst, Imperial College, London (Fellow, 1927–1929), for a further year at the Imperial College of Tropical Agriculture, Trinidad; Mr. H. K. Cameron, University College, London (Fellow, 1928–1929, at the University of Munich), for one year; Mr. H. Diamond, University College, London (Fellow, 1928–1929, at the University of Munich), for one year; Mr. F. L. Gilbert, University College, Nottingham, and Cambridge (Fellow, 1928–1929, at Cambridge), for one year; Mr. C. H. Lea, University of Liverpool (Fellow, 1928–1929, at Cambridge), for a further year at the Low Temperature Station, Cambridge. Fellowships have been awarded to Mr. C. G. Eltenton, Trinity College, Cambridge; Mr. D. L. Hodge, Imperial College, London; Mr. L. C. Bannister, Universities of Liverpool and Cambridge. The Institute has also awarded one hundred grants-in-aid to young men and women employed in chemical works, to facilitate their further studies.

IN several articles in the *Times of India*, under the title "Mathematics and Life", published last year in pamphlet form, Prof. John Maclean, Wilson College, Bombay, advocates a reform in the teaching of mathematics in the first year of university study. Hitherto at Bombay the student who is not a mathematical specialist has looked on mathematics as a fence that he must climb as best he can and then forget about, as a mere obstacle without connexion with his future life. Prof. Maclean's aim is to give the student an equipment of mathematics that will be of direct use to him in after life, whatever walk in life he may have chosen. His course would exclude all portions of mathematics that have no direct application and would give a thorough training in the more useful parts of the subject, using as illustrations problems from various walks in life; it may be problems such as arise in the career the student has chosen, it may be problems with a close resemblance to those of his career and appropriate to be dealt with by the same mathematical tools. Prof. Maclean believes that in this way he will replace the deadening teaching of the past by teaching that will make the mind alert, and the mathematical knowledge available on every occasion—he will substitute an effective education for a nugatory one. Although the universities of Great Britain show no comparable development, our schools have, during the present century, gone through the change advocated, by the scrapping of the branches of mathematics that lead nowhere and by aiming at contact with reality in the retained branches. The effect of this change on the pupils has been remarkable. The old style teaching was understood by about five per cent of the pupils, and the idea prevailed that mathematics was a special gift. On the new lines, every pupil understands and readily applies his knowledge to his own problems. We wish all success to Prof. Maclean, who is a pioneer for the university of the reform that has proved of such value in the school.

Calendar of Patent Records.

August 3, 1822.—Machine saws for felling tree have not found great favour, but many have bee invented. An early example was the subject o Mouret's patent granted for five years in France o Aug. 3, 1822. The saw is mounted on rollers and i moved to and fro by manually operated gear, bein guided in a frame so as to have a slightly circula motion. The frame itself is also on rollers, and i caused to advance slowly towards the tree with eac cut of the saw by means of weights and rop gearing.

August 3, 1832.—A 'bachelor' button which coul be attached to the garment without sewing—a typ that became very popular during the War—wa patented by John Christopher of London on Aug. 3 1832.

August 4, 1877.—The gas engine was established o a firm basis, and for the first time became a seriou competitor of the steam engine as a prime mover, whe Nikolaus Otto introduced the four-stroke engine whic he patented in Germany on Aug. 4, 1877. Otto ha been working at the problem for more than twent years, and had already in 1867 achieved partial succes with the Otto and Langen engine, but the new engin entirely superseded all others and monopolised th world's markets for many years. The improvemen was very largely due to the re-introduction of Barnett' proposal to compress the charge of gas and air befor ignition (cf. Calendar of Patent Records, April 18).

August 5, 1551.—An early reference to tin-plat manufacture and what appears to be the first instanc of a German patent grant is given by Beck in hi "Die Geschichte des Eisens", when he records tha on Aug. 5, 1551, King Ferdinand granted to Freihe Hanns von Ungnad of Steiermark the privilege to erec one or more mills for the manufacture and tinning o sheet-iron and to carry on the trade unhindered fo a period of twenty years, "in Bedacht der ansehn lichen, nützlichen, beharrlichen, hocherspriesslichen Dienste, so er sider Eingang unsrer landesfürstliche und königlichen Regierung mit ungespartem, seine Leib und Gut willig und unverdrossenlich bewiese hat".

August 8, 1777.—The first patent for a milk chur was that granted on Aug. 8, 1777, to John Rastric of Morpeth, the engineer. The churn is in the for of a barrel, with a central shaft having several set of 'dashers' and rotated by means of an externa handle. A ventilator is fixed upon the barrel.

August 9, 1913.—The possibility of the hydrogena tion of coal to oils has been recognised for many year and a great deal of experimental work has been carrie out to arrive at a practicable process, but the proble was not solved until Bergius introduced his method o subjecting bituminous coal to the action of hydroge at pressures of from 200 to 300 atmospheres an at temperatures of from 300° to 500° C., which h patented in Germany on Aug. 9, 1913. Though th technical difficulties, however, have been overcom the cost of production remains at present too high t admit of the process being commercially successful i competition with mineral oil production.

August 10, 1874.—One of the pioneers of the moder aerial ropeway system of transportation was th German engineer Adolf Bleichert, who was mainl responsible for the development of the two-ro system in which there is a fixed carrying rope and separate hauling rope, in contrast to that introduce in Great Britain in which a single endless movin rope to which the carriers are fixed is employe Bleichert's first patent was granted in Saxony o Aug. 10, 1874.

Societies and Academies.

PARIS.

Academy of Sciences, June 24.—**Marcel Brillouin**: Movements of the oceans. The Newtonian potential of the ridge in cylindrical co-ordinates.—**B. Cabrera** and **A. Duperier**: The paramagnetic properties of the rare earths. Details of measurements of the variations of the magnetisation coefficients of sulphates and oxides of the rare earths between 20° C. and 400° C. The Curie-Weiss law applies to some of the rare metals, but not to all.—**F. E. Myard**: The correct control of a motor-car.—**Bertrand Gambier**: Geometrical configuration of right lines or circles.—**S. Finikoff**: The periodic series of Laplace containing W congruence.—**Pasquale Calapso**: Rectilineal congruences on focal surfaces to which correspond lines of curvature.—**Georges de Rham**: Multiple integrals and *Analysis situs*.—**Maurice Gévrey**: Hypotheses concerning the solution of problems at the limits of the elliptic type.—**J. Delsarte**: A fundamental problem of the theory of vortices.—**R. Wavre**: A desideratum formulated by Tisserand and the theory of planetary figues.—**Marcel Chopin**: High temperature determinations of the specific heat of nitrogen and carbon dioxide. The method used aims at the nearly complete elimination of the corrections in a calorimetric measurement of the specific heats of gases at high temperatures. For nitrogen,

$$C_p = 6{\cdot}82 + 0{\cdot}00058t,$$

and for carbon dioxide,

$$C = 8{\cdot}9 + 0{\cdot}61(t/100)^{0{\cdot}673}.$$

These results are compared with earlier data.—**C. Caveau**: There is no second law (of thermodynamics). Outline of a concrete thermodynamics.—**R. Darbord**: Electrostatic calculations concerning the electric discharge between two spheres.—**Fahir Emir**: Superficial layers and superficial solutions of myristic acid. The thickness of the saturated film of myristic acid is 16 A. This is exactly half the distance found by the X-ray method (Becker and Jancke) for the solid acid, and confirms the hypothesis of Marcelin.—**Pierre Chevenard** and **Albert Portevin**: The phenomena during reheating of hypertempered steels.—**A. Hanfourche**: The oxidisability of silicon and the allotropic modification of Moissan and Siemens. Experiments on the effect of the state of division of silicon on its oxidisability and solubility in hydrofluoric acid.—**M. Tian**: The solidification of saccharose. Catalysis by water.—**A. Travers** and **Schnoutka**: The hydrated polycalcium aluminates.—**Ligor Bey** and **M. Faillebin**: The reaction of resorcinol and a new coloured indicator.—**E. Bœdtker** and **R. Kerlor**: The synthesis of a dicymyl,

$$p\,.\,p - CH_3\,.\,C_6H_4 - C(CH_3)_2 - C(CH_3)_2 - C_6H_4(CH_3).$$

—**A. Wahl** and **J. Lobeck**: The naphthisoindigotines.—**Paul Fleury** and **Jean Marque**: The reducing power of the polyalcohols towards alkaline solutions of potassium iodomercurate. The amount of reduced mercury can be utilised under certain well-defined conditions for the quantitative determination of mannitol, inositol, dulcitol, and glycol.—**L. Petitjean**: The acceleration of masses of air in atmospheric movements.—**Jean Lugeon**: A method of determining from a great distance the geographical position and velocity of certain discontinuities or meteorological disturbances by means of the atmospherics they emit.—**G. Nicolas** and **Mlle. Aggéry**: *Cerasus Caroliniana*, new example of andromonœcia. A new type of bacterial disease.—**Mlle. M. L. Verrier**: The structure of the eyes and the physiology of vision in selachians. The eyes of selachians (*Scyllium*, *Mustelus*, *Acanthias*, *Raja*) are inferior to those of the majority of other fishes.—**Gruvel**: The influence of the piercing of the Suez Canal on the marine fauna of the coasts of Syria. A description of about a dozen species of fish which have passed into the Mediterranean from the Indian Ocean and the Red Sea.—**P. Vignon** and **E. Séguy**: The presence of the raised median nervure in the Diptera.—**G. Mouriquand** and **A. Leulier**: The antirachitic action of certain cholesteric lipoids in *Helix Pomatia*.

GENEVA.

Society of Physics and Natural History, June 6.—**E. Rogovine**, **L. Wohlers**, and **P. Wenger**: A micro method for the determination of uric acid. The method, described in detail for practical applications, is based on oxidation by excess of potassium ferricyanide followed by a back titration of the excess of ferricyanide.—**Th. Stephani** and **E. Cherbuliez**: Researches on antituberculous chemotherapy (copper and the rare earths). The use of the copper and didymium derivatives of di-iodosalicylic aldehyde and of copper benzoate in solution in oil (they are insoluble in water) has given very encouraging results in the treatment of tuberculosis of the guinea-pig and also in man. These substances are innocuous and their cost is small.—**E. Briner** and **R. Wunenburger**: The ozonation of acetylene. The ozonation of this hydrocarbon with a triple bond has given rise to glyoxal, that is to say, to a substance containing the same number of carbon atoms as the hydrocarbon submitted to ozonation. On account of its great instability, the ozonide of acetylene has not been prepared in the pure state.—**Basile Luyet**: Sensitivity to the ultra-violet in *Mucor* as a function of age. Experiments have been made on *Mucor hiemalis*. By irradiating cultures of ages from 1 to 38 hours, it has been found that up to the age of 22 hours the fatal dose is 10 to 20 sec. and that it changes suddenly to 20 min. when the sporangia have been formed.—**F. Chodat**: The genetics of strawberries. Heterosis. Crossing the Dufour and Moutot varieties has given a very vigorous hybrid. The proportion of large plants was 62 per cent for the hybrid against 4·5 per cent in the Moutot descendants and 15 per cent in the Dufour descendants.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 3, Mar. 15).—**Otto Struve**: The longitude of the galactic centre as derived from the intensities of detached calcium lines (see NATURE, May 11, p. 737).—**Milton L. Humason**: The large radial velocity of N.G.C. 7619 (see NATURE, May 25, p. 811).—**Edwin Hubble**: A relation between distance and radial velocity among extragalactic nebulæ (see NATURE, May 25, p. 811).—**Harlow Shapley**: Studies of the galactic centre. (4) On the transparency of the galactic star clouds (see NATURE, May 11, p. 737).—**Selig Hecht** and **Ernst Wolf**: The visual acuity of the bee and its relation to illumination. Visual acuity was measured by the determination of the minimum illumination required to produce response to movement of patterns consisting of equal black and white bars. It varies with illumination much as does the human eye, being poor at low illuminations, and increasing with increased illumination, at first rapidly and then slowly, to a maximum. The maximum for both is between 50 and 100 millilamberts, but the human eye can resolve the environment about a hundred times better than the bee's eye. Bees can resolve the environment much more accurately vertically than horizontally. The results are in accord with anatomical findings.—

C. F. Roos: Some problems of business forecasting. Given the necessary supply functions, cost of production functions, etc., available to most business undertakings, it is possible to compute useful figures referring to replacement and enlargement of plant.—**Victor K. La Mer** and **J. W. Temple**: The autoxidation of hydroquinone catalysed by manganous salts in acid solutions: a reaction whose velocity is proportional to the driving force.—**George B. Kistiakowsky**: The temperature coefficients of some photochemical reactions. The rates of reaction of stoichiometric mixtures of hydrogen and oxygen and of carbon monoxide and oxygen have been investigated; the temperature coefficients increase with rising temperature.—**M. H. Stone**: Linear transformations in Hilbert space. (1) Geometrical aspects. Transformations in complex space which may be applicable to the formulation of the quantum theory.—**Neal H. McCoy**: On commutation rules in the algebra of quantum mechanics.—**H. S. Vandiver**: Some theorems concerning properly irregular cyclotomic fields.—**Gilbert N. Lewis** and **Joseph E. Mayer**: The thermodynamics of gases which show degeneracy (*Entartung*). A mathematical extension, to all types of molecules, of the work of Bose on photons and of Einstein on monatomic molecules.—**Albert W. Hull** and **Irving Langmuir**: Control of an arc discharge by means of a grid (see NATURE, May 18, p. 776).—**Joseph Kaplan**: The heat of dissociation of nitrogen. The value found from a consideration of the energy of the nitrogen molecule in the *D*-level is about 9 volts.—**Katharine B. Blodgett**: Exponential yield of positive ions in argon.—**F. Rasetti**: On the Raman effect in diatomic gases. Observations on nitrogen, oxygen, and carbon monoxide give results in good agreement with theory.—**Carl Barus**: Adiabatic expansion in case of vanishing increment (2).—**Edwin H. Hall**: On electrons that are 'pulled out' from metals. The 'free' and 'associated' electrons of the author's dual theory of metallic conduction are renamed 'thermions' and 'valence electrons'. A discussion of Millikan and Eyring's experimental results on the basis of this theory. The evidence indicates that the thermions are very few compared with the number of atoms (1 to 10^5 or 10^6). Valence electron conduction is effected by intermittent trains of electrons.—**Carl E. Howe**: A preliminary report on the measurement of the *Kα* line of carbon. Measurements were made by reflection at grazing incidence from a ruled grating in a vacuum spectrograph. The unweighted mean was $44{\cdot}60 \pm 0{\cdot}04$ A.—**F. Zwicky**: On the imperfections of crystals. The differences between the theoretical and observed breaking strength of crystals has led to a theoretical examination of suggested microscopical cracks in crystals. The phenomenon may be related to cold-hardening and similar effects.—**Leonard J. Neuman**: The mechanism of spark discharge. In argon at low pressures with nickel grid and sodium-coated electrodes, the liberation of electrons from the cathode by bombardment with swift positive ions is the predominating mechanism; with increasing pressure, generation of electrons in the gas by collisions between swift positive ions and neutral molecules becomes more important.—**John W. Gowen**: The cell division at which crossing-over takes place. It occurs in *Drosophila* in the chromosomes as they prepare for the first maturation division.—**George H. Shull**: An unexpected association of factors belonging to three linkage groups in *Œnothera* and its explanation.—**George D. Snell**: An inherent defect in the theory that growth rate is controlled by an autocatalytic process. The increasing volume of the growing organism invalidates the usual mass action equation applied to growth processes. Appropriate equations are derived.—**Robert Emerson**: Chlo phyll content and rate of photosynthesis. T chlorophyll content of *Chlorella vulgaris* can be c trolled by culture in a medium containing appropri salts, glucose, and less iron than is normally used. high light intensities, photosynthesis is a function chlorophyll content. The curves for rate of pho synthesis as a function of temperature at differe chlorophyll contents are similar in form.—**Morg Upton**: Functional disturbances of hearing in guin pigs after long exposure to an intense tone. There first an increase of sensitivity to the exposure f quency and then desensitisation to all intensities o but no general change in the auditory mechanis This is evidence for a 'resonance' theory of heari —**Thomas Wayland Vaughan**: Studies of orbitoi Foraminifera: the subgenus *Polylepidina* of *Lepi cyclina* and *Orbitocyclina*, a new genus.

Official Publications Received.

BRITISH.

The Journal of the Institution of Electrical Engineers. Edited P. F. Rowell. Vol. 67, No. 391, July. Pp. 813-936+xxxiv. (Lond E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Air Ministry: Aeronautical Research Committee. Reports Memoranda. No. 1185 (M. 58): The Strength of Tubular Struts. Prof. Andrew Robertson. (E.F. 199.) Pp. 44. 2*s.* 6*d.* net. No. (Ae. 382): The Skin Friction on a Circular Cylinder. By A. F (T. 2739.) Pp. 9+3 plates. 9*d.* net. (London: H.M. Stationery Offi

Annual Report of the Auckland Institute and Museum for 1928 adopted at the Annual General Meeting held on 29th May 1929. 42+2 plates. (Auckland, N.Z.)

CATALOGUE.

Ancient Geography: a Catalogue of Atlases and Maps of all Parts of World from XV Century to Present Day. (New Series, No. 3.) Pp. 14 5 plates. (London: Francis Edwards, Ltd.)

Diary of Societies.

SATURDAY, AUGUST 10.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

CONGRESSES.

AUGUST 4 TO 9.

GENEVA INSTITUTE OF INTERNATIONAL RELATIONS.

Monday, Aug. 5, at 10 A.M.—K. Zilliacus: The Structure and Workin the League of Nations.

At 8.30.—E. J. Phelan: The Future of the International Lab Organisation.

Tuesday, Aug. 6, at 10 A.M.—Norman Angell: The Economic Cause War.

At 8.30.—Henri Rolin: The Peaceful Settlement of all Disputes.

Wednesday, Aug. 7, at 10 A.M.—Prof. J. L. Brierly: The Contributio Law to Peace.

At 5.30.—H. S. Grimshaw: The Problems of Native Labour.

At 8.30.—The Unreadiness of Public Opinion.

Thursday, Aug. 8, at 10 A.M.—Arnold Forster: The Freedom of the and the Outlawry of War.

At 3.—W. T. Layton: Reparations and Debts.

At 5.30.—G. A. Johnston: Industrial Relations.

Friday, Aug. 9, at 10 A.M.—A. E. Zimmern: The Preparation of Pu Opinion.

At 3.—Prof. S. de Madariaga: The Monroe Doctrine and the Le of Nations.

At 5.30.—Prof. C. K. Webster: The Far East.

AUGUST 9 TO 12.

APIS CLUB INTERNATIONAL CONFERENCE (at Berlin).

Friday, Aug. 9, at 9 A.M. (at Institut für Bienenkunde, Berlin-Dahlem

Saturday, Aug. 10, at 8 A.M.—Excursion by car round Berlin, with spection of apicultural objects of interest in the museums, and of air-port.

Sunday, Aug. 11, at 10 A.M.

Monday, Aug. 12, at 9 A.M.—By car to Pichelsdorf; thence by stea visiting the bee-farm and mating-station of the Institut.

Papers will be read during the conference on the natural hist physiology, and pathology of *Apis mellifera*, L., the investigatio honey and wax, plant pollination, history of apiculture, etc., as we with practical beekeeping topics. There will also be communicat by Prof. Fiche on recent methods of honey analysis, and by Dr. Krot on medical investigations on bee-poison.

NATURE

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No. 3119, Vol. 124]

Darwinism and Social Ethics.

THE Bishop of Exeter, in the July number of the *Hibbert Journal*, lays his finger upon two implications of Darwinism which appeal to many as subversive of social tendencies as they exist to-day, and as they have been encouraged especially by Christianity. The first is the theory of the struggle for existence, which he regards as nothing more than a policy of destruction, forgetting that, as Kropotkin emphasised long ago, destruction is not the whole story, but that mutual aid and combination also play an effective part in the struggle in the lower as well as in the higher orders of Nature. Especially in the higher orders, it is noteworthy that spiritual and intellectual progress has been associated with the development of mutual aid and sociality, and it seems likely that along these lines future progress is most likely to be attained.

The Bishop's own examples of the help given by civilised peoples in the stamping out of disease amongst the lower races, or in the betterment of the lot of the less fortunate amongst their own people, show how clearly spiritual development (which also is evolutionary) has changed the crude notion of destructiveness. The struggle for existence is often a delicate and not very obvious process. Amongst men it has certainly lost much of the crudeness and literalness which it possesses in the world of the lower animals, and the evolution of spiritual development ensures that amongst men there can be no return to the purely physical struggle which is sometimes taken as the whole story in the lower orders.

On the other hand, it is obvious that selection of some sort must take place amongst men, and there is a real danger in the unlimited preservation of the unfittest in mind or body, always, be it noted, at the expense of the more fit. It is difficult to avoid the conclusion that, since man as he has evolved has to a large extent done away with the selection which would have resulted from an exposure to the pressures of Nature, and has replaced that by an effort after general well-being, he must accept the responsibility entailed, and, as Prof. J. Arthur Thomson once expressed it, must "continue in a subtler, more rational, more humane form the automatic singling and sifting which goes on in Nature".

The Bishop of Exeter's second difficulty lies in the specialisation apparent in the structures and functions of animals, which, applied to mankind, suggests to him the need for a political system

fundamentally different from the one under which we are at present living; one which will promote classes with specialised functions. "The equality of men is a Christian ideal, but one which should prove subversive to all evolutionary development." But the Bishop's earlier examples of higher races and lower races, of fit and unfit, show that he is no firm believer in equality, and it is evident enough that men are not equal in bodily or mental development, in spiritual development, or capacity for spiritual development.

It must be remembered that specialisation in structure or function is a device to meet a special set of circumstances, and that it implies a lessened ability to meet fresh changes in circumstances, as many extinct groups of animals bear witness. Man is still evolving, and he would be rash who would predict the developments which may be required to meet the changing circumstances of his environment.

The safety of humanity lies not in specialised and therefore fixed castes, but in the mental capacity which enables man to adapt his whole life to the needs of different conditions, as no lower animal can adapt itself. Perhaps the only safe generalisation is that neither bodily evolution alone nor mental evolution alone is likely to be of great survival value, but that sound minds in healthy bodies must combine in a co-operative social evolution wherein the individual will gradually come to mean less and progressive humanity will mean more.

A Source Book of Astronomy.

A Source Book in Astronomy. By Prof. Harlow Shapley and Helen E. Howarth. (Source Books in the History of the Sciences.) Pp. xvi+412. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 20*s.* net.

THIS book is a sheer delight. The multiplication of text-books and popular literature in astronomy, salutary as it is on the whole, has one serious disadvantage: it diverts the attention of inquirers from original sources of knowledge. The reason is obvious. Neither time nor accessibility allows of reference to a separate volume for each piece of information one may require. We need all our store of available knowledge between two covers, and so it comes about that the amateur, nourished on his handbook, and the student, looking only to his text-book, develop into the working astronomer with an almost total ignorance of the original papers of any but contemporary writers. One could probably say with truth that mo astronomers who read this volume will read th greater part of its contents for the first time, an yet it contains nothing that can be ignored witho loss or that can be assimilated from any paraphra with quite the same benefit.

In June 1924, Mr. Gregory D. Walcott, of Lon Island University, Brooklyn, N.Y., assembled a advisory board of philosophers and men of scienc with the object of producing a series of "sourc books" in the history of the sciences which woul "present the most significant passages from th works of the most important contributors to th major sciences during the last three or four cen turies". Among the members of the board wa Prof. Harlow Shapley, of Harvard College Observa tory, and he, with the assistance of Miss Helen I Howarth, has now prepared the first of the projecte series, dealing, appropriately, with astronomy. I a brief preface the compilers state some of th difficulties and general characteristics of the worl Several passages which would otherwise have bee quoted are excluded on account of their mathe matical nature or excessive length; Gauss's de scription of the 'method of least squares' is, i fact, the only mathematical note in the book. N contribution originating since the year 1900 ha been included, nor has the work of any livin astronomer been given. Those who wrote i English are represented by their *ipsissima verb* and others by English translations, many of whic have been specially made. A short note giving few relevant facts concerning each of the autho represented (of whom there are more than sixty is appended, and in some instances portraits o other illustrations appropriate to the work de scribed are reproduced. The chronological orde has been followed.

A book of this type, as the authors point out, not a history; it does not aim at completeness, an there is necessarily no attempt to link up one piec of work with another. Nevertheless, it is clear tha the choice has been partly determined by a praise worthy desire to 'see a thing through'. Thu we may follow the history of our knowledge o Saturn's rings through the contributions of Huy gens, Cassini, Maxwell, and Keeler—a consecutiv story. It should be said further that the book in no sense a text-book, on account not merely o inadequacy, but also of radical unfitness. Th authors have wisely refused to restrict themselve to accounts of ideas and discoveries which are sti accepted at their original value. Some of th matter here reprinted has been definitely supe

ded, and some has played a negligible part in ading up to modern views: it is not thereby squalified for a place among the classics of tronomy. The distinctive feature of a 'source-ook' is that it contains the actual words, written ten in the glow of excitement following a great scovery or idea, of those most worthy to be membered, and its peculiar value, we would say, s in the fact that in those words there is an notional, and sometimes a scientific, significance eyond the power of any second-hand account to produce.

It is, of course, impossible in a review to give ren an approximate idea of the character of such book. We can merely cite at random a few of e treasures which it contains. Here, for example, e may read why Copernicus found the geocentric smogony unacceptable, and how Kepler advised m "who is so stupid as not to comprehend the ience of *Astronomy*, or so weak and scrupulous as think it an offence of Piety to adhere to *Copernis*, him I advise, that leaving the study of *stronomy*, and censuring the opinions of Philophers at pleasure, he betake himself to his own ncerns, and that desisting from further pursuit these intricate Studies, he keep at home and anure his own Ground". One may renew acuaintance with Salviatus, Sagredus, and Simicius, and learn from Huygens that the art of nstructing telescope lenses "has in reserve more fficulties than it seems to bear on its face", and om Bradley that the agreement between his servations and the hypothesis of the aberration light "may possibly be thought to be too great those who have been used to astronomical servations". One may read of Horrox and Goodke, the marvellous boys who died immortal at the e of twenty-two, and of how Kapteyn estimated s enthusiasm for the Cape Photographic Durchusterung to be equal to six or seven years of udgery. The feelings of a "watcher of the skies hen a new planet swims into his ken" may be ught in the words of Herschel, but it is doubtful they will be experienced by any but a kindred irit. No such limitation characterises Huggins's count of the spectra of gaseous nebulæ.

In the midst of such an illustrious assembly, it with something of a shock that the reader counters "an extract from the Will of James ck". What is it doing in that galley? If the culiar value of a source book lies in the fact that e words of an original thinker or discoverer may expected to be 'inspired' in the only legitimate nse of the word, on what grounds can be justified the inclusion of a legal document, of all dusty formulæ the most irredeemably dead? This seems to us to be the one serious defect in an otherwise wholly admirable book.

Perfection in such a publication is impossible of achievement, and, since the standard of judgment is inevitably determined in part by individual taste, is probably without meaning. We should have liked to see a quotation from Newton's "Opticks" as indicating the origin of astrophysics, as an example of the ideal manner of describing experimental researches, and as a timely reminder that Newton was not only a great philosopher but also a great experimenter. This seems the more desirable, as the quotations by which Newton is represented, worthy in many respects though they are, contain an undue proportion of misapprehensions. The laws of motion and gravitation, now superseded, could, of course, not be omitted, but was it necessary to repeat the conclusion that "the least particles of all bodies" are "extended, and hard and impenetrable . . . and this is the foundation of all philosophy"? Or that the possibility that the solar system moves among the stars is "an hypothesis hardly to be admitted"? But doubtless every reader will miss some favourite passage or regret the inclusion of some other. It is wiser and more fitting to enjoy the rich treasure so handsomely compiled and presented than to give the rein to individual prejudices.

'Handsome' is not too strong a word for the outward form of this charming book. It is admirably printed and bound, and the reading is a physical as well as a mental pleasure. In matters of detail only two defects have been noticed. On p. 371 the caption under the illustration refers to "ξ Ursæ Majoris" instead of "ζ Ursæ Majoris", and in the account of Horrox's observation of the transit of Venus, it would have been an advantage if the month of observation had been definitely stated in the footnote. H. D.

Crystallochemistry.

Crystal Structure and Chemical Constitution: a General Discussion held by the Faraday Society, March 1929. Pp. iv + 253-422 + 6 plates. (London: Faraday Society; Gurney and Jackson, 1929.) 8*s*. 6*d*. net.

THE Faraday Society is justly proud of its record of general discussions, the subjects of which have covered a wide field during the quarter-century of its existence. The meeting held last March contained an innovation in that

the proceedings started with a formal lecture, and although the subsequent programme was divided into special sections, yet it was Prof. Goldschmidt's opening discourse that sounded the note for all that followed. The report of this conference, which has just appeared, includes all the contributions, many of them by workers distinguished in particular directions in crystallochemistry, and forms a unique collection of opinions and researches upon the nature of the solid state.

Modern theories of crystallography differ from those of even a few years ago chiefly in the method of classifying crystals. Instead of the macroscopic symmetry the atomic environment is now the basic criterion, as expressed by the co-ordination number, *C.N.*; for example, in the well-known rocksalt structure, $C.N. = 6$, meaning that each sodium ion is surrounded symmetrically by six chlorine ions, and vice versa. A combination of X-ray results and optical data has enabled tables of atomic radii to be prepared for the great majority of the elements. This property, however, is not a constant, but depends not only upon the electrical charge but also upon the state of co-ordination. Thus the radius of $S^{6+} = 0{\cdot}34$ A., whereas that for $S^{2-} = 1{\cdot}74$ A. Likewise, the figures for 12-co-ordinated and 4-co-ordinated tin are 1·58 A. and 1·40 A. respectively. These facts show the impossibility of deducing atomic radii correctly, unless crystals are divided into what Goldschmidt calls 'commensurable' groups in which the constituents are in corresponding states of ionisation and environment (or co-ordination).

The quantity *C.N.* is, nevertheless, itself a function of the quotient of the atomic radii of the components, and also of their polarisation or capability of deformation by an electric field. Special types of crystal structure, the molecular lattice and the layer lattice, arise when distortion of the units is very marked. Again, the peculiar nickel arsenide form is found for compounds of the iron family: in these elements the *M*-defect renders the removal of electrons harder than for a metal such as magnesium. Finally, the occurrence of more than one kind of linkage within the crystal is probably responsible for the appearance of the iron pyrites structure, which contains the complex S_2 as a unit.

Prof. Goldschmidt remarks that chemical substitution is the most powerful tool of the investigator in crystallochemistry. Certainly in the hands of the Oslo school it has fashioned a foundation stone upon which to rear a great edifice of systematic inorganic chemistry.

Turning now to the papers contributed to th general discussion proper, those in Part 1 de with inorganic substances, and here again the pa played by atomic arrangement is noticeable. Pro W. L. Bragg's account of the work undertaken Manchester on the silicates provides some fascin ating reading. Broadly, these structures are lik fabrics the stitches of which are groups of oxyge atoms, which groups hold together by commo sharing, while the positive ions are widely disperse throughout the network.

Prof. Lowry and Mr. Vernon present a study the etch figures of sylvine, which confirms i ionic character, and Dr. A. M. Taylor some inte esting reflections upon the AX_4 group, the linkage within which appear to be semi-polar. Othe papers include a contribution by Prof. Jaegar o ultramarine, and one on the fine structure of th felspars by Prof. Schiebold.

The introduction to Part 2 (organic compounds is by Sir William Bragg. Mrs. Lonsdale deals wit the history of the benzene ring question, and wit her own work on hexamethylbenzene. The rin is definitely plane, and the side chain carbo atoms are placed radially to their respectiv nuclear atoms, and lie in the plane of the hexago Dr. Müller describes his hydrocarbon model, an Dr. Piper produces some examples of the ways i which the long spacings (20 A. to 50 A.) of fatt acids have been made to yield valuable data o composition.

Mr. Bernal, in opening Part 3 (metals), produce perhaps the most suggestive contribution in th report. The physical properties of metals hav hitherto been studied almost exclusively on accou of their technical importance, and the purel scientific aspect has remained comparativel barren. The term 'metallic state' includes bodi in which the binding forces may be homopolar ionic: meanwhile, the empirical requirements the metallic bond (which is different from eithe are clearly displayed and their interpretation di cussed. The following paper, by Westgren an Phragmén on alloys, is distinctly illuminating the light of the foregoing.

Experimental and instrumental interests a represented by the two-circle spectrometer due Dr. Wooster, and the integrating microphotomet for which Mr. Astbury is responsible.

Part 4 consists of a group of papers of a mo general character (Kolkmeijer, Mark, Mölle Porter, Reis, Weissenberg), which produced at th meeting a lively exchange of views. Prof. Ewa brings the formal contributions to a close mo

appropriately with a masterly account of the new Heitler-London theory of chemical combination. That aspect of quantum conceptions most readily approached by the theory of groups finds a natural place alongside the labours of the practical crystallographer.

Just over forty years ago (May 1889) Mendeléeff expressed his ideal in the words: "To hasten the advent of true chemical mechanics." Here is a collection of papers which constitute no mean step towards that goal.

F. Ian G. Rawlins.

The Nature of Epidemicity.

The Genesis of Epidemics and the Natural History of Disease: an Introduction to the Science of Epidemiology based upon the Study of Epidemics of Malaria, Influenza, and Plague. By Lieut.-Col. Clifford Allchin Gill. Pp. xxvi + 550. (London: Baillière, Tindall and Cox, 1928.) 21*s.* net.

THE prevalence of many infective diseases in epidemic form—by which is meant a sharp increase in incidence over a short period of time—is a problem the solution of which has exercised many minds since the times of the medical philosophers of ancient Greece. Many of the hypotheses formerly advanced have been found to be inconsistent with increasing medical knowledge, and there is no unanimity of opinion among epidemiologists concerning those that have survived. Only a careful collection and unbiased analysis of all the factors and data, together with the vision to interpret them, is likely to unravel the tangled skein.

Lieut.-Col. C. A. Gill, Director of Public Health in the Punjab, has now ventured into this 'no man's land' and has produced an impressive book, the outcome of a painstaking study of epidemics over many years, in particular of malaria. The subject matter is presented in five parts. The first part commences with a statement of definitions, which are particularly good, proceeds to survey ancient and modern hypotheses regarding the cause of epidemics and the methods of epidemiological research, and concludes with a presentation of the author's hypothesis of the nature of epidemicity. In Part 2, the known facts respecting epidemic malaria, and also influenza and plague, are stated at length. Part 3 contains a discussion of the general properties of epidemics and a critical analysis of the author's hypothesis. Part 4, entitled "Bionomics of Disease", deals with evolutionary factors and influence of climate in health and disease, and Part 5 contains a general review of the subject, with final reflections. The book is illustrated with charts and maps and a diagram of the endemic and epidemic status of communities.

The varying clinical characters and epidemiological features exhibited by the different epidemic diseases, together with the individuality of their specific parasites, almost inevitably suggest that a dissimilar mechanism is operative in the causation of epidemics. The dominant view at present held is probably that the quality of epidemicity is inherent in variability of the properties of the specific parasite, and that epidemics are the outcome of biological modifications of the latter—the mechanism of epidemicity is essentially an attribute of the specific parasite. Col. Gill, however, brings forward some weighty considerations opposed to this view, and maintains that arguments in favour of a unitary nature of the mechanism of epidemicity are no less formidable. His hypothesis, which he designates the 'quantum theory', suggests that *all* epidemic manifestations consist essentially in a loss of equilibrium between the dose of toxin (or the parasitic factor) and the degree of resistance of the community attacked. The quantum theory postulates

"that all epidemical phenomena are essentially dependent upon a change in the relationship of the infection quantum and the immunity quantum. It ascribes the precise cause of 'loss of equilibrium' between 'infection' and 'immunity', primarily and predominantly, to an increase of the infection quantum—the essential factor in the causation of epidemics is of a quantitative rather than a qualitative character. . . . An epidemic is thus regarded as mainly the outcome of a quantitative change of the transmission factor and the immunity factor, and the intensity of epidemics is held to be a function of the range of amplitude of these factors, which in turn is attributed to the influence of climatic conditions in determining a great and sudden elevation of the infection quantum and a corresponding depression of the immunity quantum."

The arguments presented in support of this hypothesis are skilfully marshalled and are mainly based upon a consideration of malaria, plague, and influenza. It must be left to the statistician to evaluate the precise significance that can be attributed to some of the figures adduced, but in the case of malaria and plague, the evidence brought forward seems strongly to support the author's hypothesis. As regards influenza, we think he is on more debatable ground and the evidence is perhaps less convincing, though this may be more the fault of the extreme complexity of the influenza problem.

Recent studies on diphtheria, which, though not

quite comparable to the diseases discussed, shows periods of epidemic prevalence, tend in one respect to support the author's hypothesis, for it has been shown that the parasitic factor, the diphtheria bacillus, exhibits a remarkable degree of constancy as regards virulence—that is to say, it presents little variation qualitatively. The studies of Sir Leonard Rogers on cholera and other diseases also support the hypothesis of the close relationship between climatic conditions and the occurrence of epidemics.

The author appears to ascribe more importance to an increase in the amount of infection relatively greater than the depression of communal immunity in the genesis of epidemics, but it does not seem clear upon what grounds. In the case of diphtheria, and also of measles, the evidence appears to us to be in favour of depression of immunity being the more important factor. These, however, are side issues, and the author would be the first to admit that he has been able to adduce few certainties. He has undoubtedly produced a work of considerable importance and a hypothesis which deserves the careful consideration of epidemiologists. R. T. H.

Progress in Psychiatry.

Recent Advances in Psychiatry. By Dr. Henry Devine. (The Recent Advances Series.) Pp. x + 340. (London: J. and A. Churchill, 1929.) 12*s.* 6*d.*

DURING the post-War years, and more particularly since the Royal Commission on Lunacy completed and published its labours, the subject of mental disorder has been one of universal public interest. Dr. Henry Devine, the superintendent of the Holloway Sanatorium, was entrusted with the work of writing the volume in Messrs. Churchill's well-known "Recent Advances" series dealing with this subject.

Dr. Devine has carried out what proved to be a very difficult task with extraordinary thoroughness, and is to be congratulated on a very fine piece of work. Anyone conversant with the extent of the field in mental disorder and its cognate subjects will marvel at the success which has crowned the author's effort to cover as much of the ground as possible. He is careful to emphasise what is perhaps one of the most important attitudes towards mental disorder, namely, that no single etiological factor, in practically all instances, is sufficient to account for the disease. In all cases there are at work closely inter-related mental and physical causes—mental stress, acute or chronic, on one hand, and heredity, focal infection, organic disease and disorder of the internal secretions, on the other.

After a well-balanced discussion of the basis of psychiatry, the author divides the rest of his book into five parts. The first part deals with toxic, infective, and somatic factors in the causation of mental disorders. In this section he discusses the very important subject of the effect of toxic agents on the germ plasm, and concludes that there is a very close relationship between hereditary disease and a psychopathic predisposition. At the same time, he is careful to emphasise the very great importance of focal infections in all parts of the body as causative agents. The important fact is that in the majority of cases these infections are not discovered except by highly skilled biochemical and bacteriological work. This point cannot be emphasised too strongly. Physical examination of a patient by the family doctor is quite insufficient; it is work for highly skilled research workers, of which there are far too few in Great Britain.

In the second part, Dr. Devine discusses the development of what is commonly known as protein shock treatment and other similar forms of treatment, leading up finally to the now almost universal treatment of that most fatal of maladies, general paralysis of the insane, by benign tertian malaria. The author gives a well-balanced account of this most interesting department of therapeutics. In the third part, he discusses the various biochemical and physiological aberrations which are to be found in mental disorders. Perhaps the most important subject in this section is the work of Golla on the physiological investigation of pleasure and pain and of the neuroses. In the fourth part, he discusses what is one of the most recent and most interesting developments of modern psychiatry—the influence of physical and psychological types.

In the fifth and last part, the author deals with the purely mental aspects of mental disorder in a reasonable and impartial manner. Into this section he brings the important work of Pavlov on conditioned reflexes. The chapter entitled "The Morbid Mind" is the best chapter in the whole book, and one from which every morbid and every normal mind would gain great benefit by reading. Dr. Devine wisely points out that psychotherapy is of very limited use in the treatment of the insane except in the direction of occupational therapy and the attitude of the mental nurse, which are really indirect or environmental forms of psychotherapy.

This book will remain a standard record of progress in a branch of medicine which is all too frequently adversely criticised by the public.

Our Bookshelf.

Methodik der wissenschaftlichen Biologie. Herausgegeben von T. Péterfi. Band 1: *Allgemeine Morphologie.* Pp. xiv + 1425. Band 2: *Allgemeine Physiologie.* Pp. x + 1219. (Berlin: Julius Springer, 1928.) 188 gold marks.

The aim of the editor and his forty-two expert collaborators has been to produce an account of the most trustworthy methods which have been employed in biological investigation. The first volume opens with an introduction to the mathematical treatment of biological questions including graphic methods, and this is followed by chapters on microscopical optics, including measuring, drawing, polarisation and ultramicroscopy, on vital staining, tissue culture, microdissection and microisolation, and on the methods for making permanent preparations and sections. The next part, on cytology, by Dr. K. Bělař, is noteworthy for the lists of the most suitable animals and plants for the study of cytoplasm, and in the succeeding part on methods for the examination of Protozoa he is equally helpful in indicating the most suitable examples for study. Chapters follow on histological and histochemical methods, on embryological and anatomical material, and on the microtechnique of invertebrates.

In the second volume the opening chapters on zoological and botanical museum technique are followed by others on the collection of living animals of various groups, and the keeping of them in fresh-water or sea-water aquaria, or in vivaria; special attention is devoted to insects (with an appendix on Lymantriidæ and Saturnidæ) and to mammals. The culture of algæ and fungi, and the keeping and rearing of higher plants as objects for the study of heredity or for physiological work, are considered. Excellent accounts are given of methods of illustration for natural history purposes by photography, microphotography, and kinematography. A chapter follows on variation, correlation, proving the agreement between empirical and theoretical figures, the analysis of inheritance factors, etc. The developmental mechanics of plants and of animals, including methods of artificial parthenogenesis, and the more important physiological methods as applied to animals and plants, are the subjects of the concluding chapters. An appendix gives technical names in German, English, French, and Italian.

This is a valuable work of reference for biological laboratories; advanced students and investigators who turn to it will find helpful information and suggestions over a wide range of biology, and the list of published works at the end of each section directs the reader to memoirs with further details. The chapter on the collection of living animals deals only with fresh-water and terrestrial examples; some account of the methods of collection of the more important marine animals would have been welcome.

The work is excellently produced and each volume has a good subject index.

(1) *The Excavations at Ur and the Hebrew Records.* By C. Leonard Woolley. Pp. 61. (London: George Allen and Unwin, Ltd., 1929.) 2*s.* net; paper, 1*s.* net.

(2) *Biblical Anthropology compared with and illustrated by the Folklore of Europe and the Customs of Primitive Peoples.* By the Rev. H. J. D. Astley. Pp. vii + 262. (London: Oxford University Press, 1929.) 12*s.* 6*d.* net.

(1) Those who know Mr. Leonard Woolley's "Sumerians" will turn with interest to his Arthur Davis Memorial Lecture on the bearing of his discoveries on Biblical history. Mesopotamia is, of course, a long way from Palestine, and "the periods with which we have to deal are sometimes far removed in time from those which interest most the Bible student", yet the link is there. The two points of contact which concern us most would seem to be the flood narrative and the story of Abraham. Of the first we read that "such archæological data as we possess, and the traditions of the Sumerians themselves, are most easily explained and best reconciled by the assumption that the Flood was the epoch-making historical event which they believed it to be". As for Abraham, the chief point of interest is that "living at Ur, so far from being a primitive Bedouin accustomed only to the wide spaces of the desert, he was the heir to an age-old civilisation sharing the complex life of a great trade centre". Another interesting point is that "it would not be even fanciful to hold that Jacob's dream was based on tales he had been told of the ziggurat of Ur, where on festivals the priests went in procession up and down the long stairways which led from earth to Heaven".

(2) The comparatively new science of anthropology, or the study of man apart from religious and cultural prepossessions, has also shed much light on story and custom in the Bible, as Sir James Frazer's monumental "Folk-lore in the Old Testament" has shown. Canon Astley's book is in part a collection of articles contributed to such periodicals as the *Hibbert Journal* and the *Modern Churchman*, and should prove most interesting material for the Biblical student who is fascinated by anthropological parallels between what he finds there and religious custom in other parts of the world.

J. C. H.

Colloid Chemistry. By Prof. The Svedberg. Second edition, revised and enlarged in collaboration with Arne Tiselius. (American Chemical Society Monograph Series, No. 16.) Pp. 302. (New York: The Chemical Catalog Co., Inc., 1928.) 5.50 dollars.

The first edition of this book was reviewed in these columns in 1924, and this new edition is a revised version with some fifty pages of additional matter. The original scheme of the book, in so far as relatively greater space is devoted to the author's own investigations, is retained, and in consequence there is a freshness and reality in presentation which a mere compilation so frequently lacks. The amendment of the old text has been thoroughly carried out, and the strange method of printing some of

the formulæ has been avoided; crude or inconvenient methods of investigation have given place to better ones wherever the latter have been devised.

The work of the author on sedimentation equilibria with the ultracentrifuge has carried this method of attack on the problem of the size of colloid particles into realms hitherto undreamt of, and those who desire a concise and readable account of this fundamental work will find it here. The extension of the investigation from the inorganic sols, to which it was first applied, to colloids of biological interest, has resulted in the determination of the molecular weights of the latter, which hitherto had been found only in a few cases by more tedious methods. New work in ultramicroscopy, in the technique of measurement of diffusion and cataphoresis, and in the application of X-ray analysis to the study of sols and gels, has been carefully incorporated. No chemists or physicists interested in colloids should miss reading this book, even if they have already enjoyed the first edition.

P. C. L. T.

Comparative Vocabularies of Bushman Languages. By D. F. Bleek. (University of Cape Town: Publications of the School of African Life and Language.) Pp. vi + 94. (Cambridge: At the University Press, 1929.) 7*s.* 6*d.* net.

IN this volume, Miss Bleek has worked on eleven vocabularies, the materials for which for the most part have been collected by herself at one time or another. In her previously published study of the Naron she gave a preliminary account of the classification of Bushman languages which is here elaborated. The languages are divided into three groups, of which six belong to the southern group, three to the northern, and two to the central. The groups differ in the characteristic clicks and in change in root and grammar, especially the last. In the introductory section which deals with the peculiar features and characteristics of the groups, Miss Bleek has analysed Bushman physique and culture with the view of a possible coincidence in distribution of language and race. The smallest average in height is found in the southern group. As regards culture, all Bushmen live in bush huts, and are hunters and collectors of food. The Hottentots, who have taken to a pastoral life, used huts in the old days, but they differed from those of the Bushmen in being made of reed mats and not bush. The clothes of all Bushmen are similar, a leather loincloth and small kaross. The ancestors of the southern group painted and engraved in stone down to a recent date, but have now lost the art. The general conclusion at which the author arrives is that, while a number of features are common to all, a good many differences in custom coincide with differences in speech.

Chemistry in Daily Life. By Dr. Samuel Glasstone. Pp. vi + 250. (London: Methuen and Co., Ltd., 1929.) 6*s.* net.

DR. GLASSTONE'S book is of a type which should be very welcome. It deals with a number of aspects of chemistry which are of interest in daily life, and each chapter concludes with a few questions, som subjects for essays and discussion, suggestions fo further study, books to read, and suggestions fo experiments. The contents are based on a cours of extension lectures and some B.B.C. broadcas talks, and the style and choice of material are bot excellent.

The author expresses the hope that the book wil be found of interest to the general reader, useful a a basis of extension and similar lectures for adults and suitable for use in schools, whether chemistr is taught or not. There can be no doubt that i will fulfil all these requirements satisfactorily. Th information is generally accurate, and the treat ment is more detailed than usual in books of thi type, so that even advanced students will find muc that is new to them. Symbols and formulæ ar used. The least satisfactory parts are some o those dealing with the early history of chemistry On p. 5 the really valuable contributions to ex perimental chemistry made by the Alexandria chemists are not given proper credit, and on p. 8 it is stated that there are representations of glass blowers on Egyptian inscriptions so far back a 3000 B.C. These are minor faults and the boo may be strongly recommended.

Lumineszenz-analyse im filtrierten ultraviolette Licht: ein Hilfsbuch beim Arbeiten mit de Analysen-Lampen. Von Prof. Dr. P. W. Danck wortt. Pp. vi + 106 + 16 Tafeln. (Leipzig Akademische Verlagsgesellschaft m.b.H., 1928 6·50 gold marks.

THE main subject matter of this little book ha become familiar to most workers in practical science even if only by witnessing a few fascinating demon strations at some conversaziones. Most of thes can be repeated with some form of the well-know tent or camera, open and curtained in the front, i the roof of which is concealed a quartz mercur burner; the light is filtered through a 'sky-light of Wood's glass, which allows only the ultra-viole rays to fall on the object placed on the floor of th tent. While such phenomena appeal to the lay man, they open up a far wider field to the imagina tion of the scientific worker and the technologis and the object of this handbook is to broade the horizon and lure the reader to explore muc further by pursuing observations in his ow laboratory.

The invitation is irresistible to the chemist, th mineralogist, the pharmacist, the toxicologist, th biologist, and the industrialist, who may differen tiate between substances so closely allied that the are in ordinary practice indistinguishable eith chemically or physically, for example, olive oil different grades; or between substances essentiall different although similar in appearance, such a a normal paper and the same after acetylation.

Of the forty illustrations one may be selected- the fluorescent structures in the sporangia of a fe are revealed in striking contrast, whereas all appe similar in daylight. The book is well written an well produced; while its value is enhanced by comprehensive, classified bibliography.

Letters to the Editor.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Natural Selection.

IN NATURE of June 8 there appears a letter from my friend Prof. Poulton in which he replies to my statement that 'natural selection' affords no explanation of evolution. He quotes *in extenso* a letter from Darwin to the distinguished American botanist Asa Gray, in which Darwin endeavours to deal with the objection that natural selection is a truism and that variations are produced by definite causes and are not due to 'chance'. Darwin compares the action of natural selection to that of a man building a house from stones of all shapes found at the foot of a precipice on a mountain-side. The shapes of these stones, he says, would be due to definite causes, but the uses to which the stones were put in building the house would not be explicable by these causes.

Of course, when I wrote the statement which Prof. Poulton criticises, I was well acquainted with this letter of Darwin. Prof. Poulton quotes it with the same reverence as our fathers used to quote a passage from Holy Writ; but a false analogy and piece of thoroughly bad reasoning seem to me to be as worthy of censure when the author is Darwin as they would be if the author were one of his religious opponents.

A little reflection will show the fallacy in Darwin's argument. That the shapes of stones on the mountain-side are due to definite causes is obvious to anyone who has ever compared a scree on a hill-side of Harlech grits with one on a hill-side of Llanberis slates—to go no farther away than Wales for an example. But when a man begins to build a house, we have the intervention of a *definite purpose* directed towards a *fixed end* and governed by a *clearly-conceived ideal*—and it is doubtless true to say that these psychic factors have no conceivable relation to the causes which produced the stones.

'Natural selection' means, as I said before, merely that a creature survives in a given environment; as to why it survives, or whether its survival be due to one character more than another, and as to how it acquired that character, the theory gives us no information whatever. The supporter of the 'mimicry' theory, when he finds one insect superficially resembling another belonging to a different family or order, *assumes* that it is because of this resemblance that one of the insects survives. It may be so, but there is no proof that it is so; it ignores the fact that the most marvellous resemblances often occur between insects belonging to different orders *inhabiting different countries.*

The supporter of evolution by 'natural selection' further assumes that the insect which survives is one of a large number of differing types produced by 'variation', that is, 'chance', which happened to fit the environment, and that all the others perished. This, again, is an unsupported assumption; in fact, one may go further and say that it is definitely not true. When in the wild we meet, as we occasionally do, with ill-adapted types such as albinos, melanics, etc., they belong, as Uexküll has well said, not to the *natural*, but to the *pathological*. Darwin, through constant usage, had grown to personify natural selection, and sub-consciously to regard it as a purposeful agency. It became a habit, and was shared by his family. I have even heard one of them talking of the 'mistakes' made by 'natural selection'. The whole mental attitude is a first-class example of the error due to what McDougall calls the "reification of words".

That when a species of animals is examined a general type can be discriminated and that individuals deviate slightly from this type, no one would deny. But to what are these deviations due? Even Morgan admits that they are due to the environment, "for there is no other source for them". Did Darwin, then, mean to say that the changes produced in a creature by the environment have no relation to its survival in that environment? If he did so, is it not obvious nonsense? No! There is no escape from the dilemma so ably posed by the late Dr. Bateson: "Either variation is due to chance or to the reaction of the animal to the environment".

That natural selection is a reality no one, who like myself has for the last seventeen years raised annually thousands of larvæ of the same species, would doubt for a moment. But what is 'selected' is not the 'random' variation but, as Kammerer has well put it, "the most plastic individual", that is, the one which reacts best to the environment; in other words, *the most vigorous*. As to why individuals of the same brood differ from each other in vigour we do not fully know, but we are beginning to get glimmerings of the reasons. If, for example, we obtain eggs from a sea-urchin at the end of the season, these eggs, though to all appearance ripe and normal, are able to give rise only to feeble larvæ which live only a day or two and only complete the early stages of development. Again, it has recently been shown that the position in the ovary of the immature egg has much to do with the vigour of its constitution when ripe and fertilised.

As to attacks of birds on insects, Prof. Poulton has failed to note that I said "serious attack". That birds occasionally attack insects I am well aware. I have myself seen the sparrow, normally a grain-eating bird, chase one of our common cabbage white butterflies, and I have seen some of the jealously guarded treasure of damaged butterfly wings which Prof. Poulton has collected after a search of many years. But that butterflies are subject to such decimating attack that the occurrence or absence of a patch of colour means life or death there is no evidence whatever.

I have written at some length on the subject, because, although I recognise that the facile truism of 'natural selection', so easily grasped by the uncritical mind, did succeed in making mankind believe in evolution, yet now I am convinced that the view that 'natural selection' explains evolution is one of the greatest hindrances to biological science. It leads to unsupported hypotheses, and to facile teleological explanations which dispense with and discourage research into the functional significance of the organs of animals. Why has an animal got a particular pattern or shape? Because it has been developed by 'natural selection' in order to enable it to escape its enemies! With this explanation too many biologists are content. "Verily all things are possible to him that believeth."

E. W. MACBRIDE.

Imperial College of Science, S.W.7,
June 29.

Super-cooled Water.

IN a recent letter to NATURE (Feb. 16, p. 244) I directed attention to Beilby's observation that water drops become hard when chilled to − 12° C., and to the fact that water is quite fluid at − 9·3° (White and Twining, *Jour. Am. Chem. Soc.*, **50**, pp. 380-389; 1913). That an important change in properties takes place

between these temperatures is indicated by the difficulty all experimenters have had in cooling water below − 10°. It may be that here the steady expansion which water undergoes below 4° ceases, and that with further lowering of temperature the contraction obtains which was predicted by Bridgman (*Proc. Am. Acad.*, **47**, p. 543; 1911–12). Water has been cooled in capillary tubes to − 18·5° (T. Borovik-Romanova, rev. in *Chem. Abs. Am. Chem. Soc.*, **19**, p. 3186; 1925), and as fine drops suspended in oil to − 20° (M. L. Dufour, *Arch. Sci. Geneva*, **10**, p. 350; 1861), but no information is given as to the physical state at these temperatures.

Two observations may be cited which are difficult to fit in with the result obtained by Beilby. Crystallisation of super-cooled water may be prevented either by keeping it perfectly still or by rapid movement, and R. Pictet cooled water to − 19° by subjecting it to constant agitation (*Arch. Sci. Geneva*, **1**, p. 498; 1878). Mousson found that a copper rod passed through a column of ice when it was under the melting pressure at − 18° (*Pogg. Ann.*, **105**, pp. 161-174; 1858). Thus, if water becomes glassy at − 12°, we have the surprising result that vitrification can be prevented by movement of the liquid, and that under great pressure the glass is liquefied.

By the kindness of the Union Cold Storage Company, observations were made at their Cannon Street stores in a chamber the temperature of which was on one occasion − 17° and on another − 22°. Drops of water at + 15° were chilled by contact with a glass slide. The larger drops crystallised to form negative spherulites, but smaller ones averaging 1 mm. to 2 mm. in diameter remained isotropic. When a steel point was brought sharply down on to the drops, they crystallised with an audible click: the point did not penetrate the drops and the inference is that they were hard. The possibility must be considered, however, that the velocity of crystallisation is so great that it is ice which is being tested and not water. Walton and Judd have found that the linear velocity of crystallisation increases with super-cooling and is 11·4 cm. per sec. at − 9°. They were unable to determine the temperature and value of the maximum velocity owing to the spontaneous crystallisation which occurred below − 9° (*Jour. Phys. Chem.*, **18**, p. 722-728; 1914).

Apart from its intrinsic interest, definite knowledge of the physical state of water would be valuable in the application to ice of those theories of solid structure and flow which are based on the conception of a liquid cement binding the grains of the aggregate together, and on the production of liquid at the surfaces of slip. The subject is also of interest in view of the fact long known and recently so conclusively demonstrated by Köhler ("Untersuchungen über die Elemente des Nebels und der Wolken", *Akad. Abhandl.*, Stockholm, 1925) that clouds at temperatures down to − 28° (at least) are composed of water drops. It may be noted here that the deposit on the cooling pipes at the Cannon Street stores was found to be a mixture of water drops and ice—this at − 22°. Direct passage from the vapour to the vitreous state has been obtained in other substances than water, and sudden vitrification with falling temperature would be in accordance with the general behaviour of super-cooled liquids. E. Berger has directed attention to the similarity between the glasses and water, in that with super-cooling a relatively rapid increase of viscosity takes place (*Glastechn. Ber.*, **5**, pp. 399-400; 1927).

That vitrification should be prevented by movement or pressure, however, is so anomalous as to call for further examination. I have no opportunity to pursue this work, but it is to be hoped that a careful study of the properties of water below − 10° will be undertaken; the investigation could be most conveniently carried out where low winter atmospheric temperatures are experienced.

LEONARD HAWKES.

Bedford College,
Regent's Park, N.W.1,
July 6.

Occurrence of Sea Urchins on the Foreshore in Britain.

IN the latest number of the *Journal of the Marin Biological Association* (vol. 16, 1, p. 289), Dr. J. H Orton discusses the occurrence of the common se urchin, *Echinus esculentus*, on the foreshore. In vie of the fact that, in comparison with Plymouth, thes animals can frequently be picked up at low tide a Millport and the Island of Skye, it may be of interes to put on record some observations made by me i August 1923 at Fetlar, in the Shetland Island especially as this island, lying in lat. 60° 35′ N., i some 3° farther north than Skye, from which record by Dr. Lebour are quoted by Dr. Orton.

The shore at Fetlar is for the most part very rock and often precipitous, sometimes with pinnacles juttin out of the water. I can remember picking up *E esculentus* between tidemarks on several occasions i the big sheltered bay, called Tresta Wick, on th south side of the island. Others were obtained fro the sides of the rocky pinnacles just below the wate level, while one was found on the side of the ston steps of the private landing stage. All were appar ently normal and active, and of a large size. So fa as my recollection goes, I do not think they wer discovered at any period of exceptionally low sprin tides.

The temperature of the water was decidedly lo and though I have no exact figures (which coul probably be obtained from the Meteorological Statio at Lerwick), I can vouch for the fact that the wate was sufficiently cold to make shore collecting wit bare feet a distinctly painful process. During th last few days of my stay, the Shetlands were swep by a terrific gale accompanied by very high seas, a the result of which no more sea urchins could b found. Presumably they had either been dislodge by the waves or had migrated to deeper water fo safety.

The fact that the occurrence of *E. esculentus* on th foreshore appears to be more common in the northerl parts of the British Isles than in the south woul seem to emphasise, as Dr. Orton points out, a direc correlation between the temperature of the wate and the life of the animal.

C. C. HENTSCHEL.

Biology Department,
St. Bartholomew's Hospital and College,
London, E.C.1, June 8.

IN the *Jour. Marine Biol. Assoc.*, vol. 16, No. May 1929, Dr. J. H. Orton asks for informatio regarding the occurrence of *Echinus esculentus* abov low water mark on the British coasts. On the nort coast of Scotland I have observed this species a different times of the year. Between April 8 and M of this year, *E. esculentus* was quite plentiful abov low water mark on the rocky shores of the west sid of Loch Eireboll, more especially in the numerou bays and inlets around Rispond, the organisms havin frequently become stranded in the rock crevices as th tide fell. During August and September, on th other hand, this species is not quite so abundan although on many occasions I have captured spec

mens with a landing-net as they retreated down the rocks with the ebbing tide.

I cannot find any reference in my notes to the occurrence of *E. esculentus* on the limestone headland of Heilim on the east side of the loch. This is peculiar because, since the headland is of much eroded limestone affording a fine habitat for a multitude of organisms, I have examined it frequently during low water spring tides.

This would suggest that the nature of the rock—its physical nature or its chemical composition—might be a possible factor affecting the occurrence of *E. esculentus*. This point is being further investigated.

Douglas M. Reid.

Science Schools, Harrow-on-the-Hill,
Middlesex, June 25.

Dinosaurian and Mammalian Remains in South India.

My attention has been directed to an article on "Geological Exploration in India—Dinosaur Remains Unearthed" contributed by Dr. Matley to the *Records* of the Indian Geological Survey, 1929, in which he refers to a preliminary note on the fossil finds from Ariyalur—Trichinopoly Cretaceous area—published by Mr. B. R. Seshachar and myself in the *Mysore University Journal* (vol. 1, No. 2, July 1927). He writes that this party (zoology students) has been "fortunate in finding a number of dinosaurian bones including a vertebra, ilium, scapula, coracoid, head of a humerus, a tooth with a portion of the dentary, and limb bones,

Fig. 1.—Fossil mandible of a carnivore taken in the Ariyalur area.

mostly in a broken condition. This discovery is of importance, as it is the first time that Southern India has yielded identifiable remains of dinosaurs." In the article referred to by Dr. Matley, there is a brief description of the humerus and carpal nodules and a broken amphicœlous vertebra of an ichthyosaurian, besides the ungulate remains of molar teeth of both perisso- and artiodactyles.

A detailed treatment of this interesting collection was deferred with the view of exploring the region more thoroughly, so as to obtain more evidence of the occurrence of the reptilian and mammalian fossils in the Trichinopoly area. In an expedition conducted to this place in December last, we have, in spite of the unfavourable weather conditions prevailing at the time, been fortunate in obtaining some more fossils. Among them we found a portion of a carnivore mandible with the teeth beautifully preserved, a large number of molar teeth of artiodactyles, together with tarsal, metatarsal, and phalangeal bones, humerus and femur, tibia, radius and ulna, scapula and broken specimens of vertebra of both carnivores and ungulates. Our collection is by no means exhaustive, but is sufficient to establish the occurrence of both reptilian and mammalian fossils in the area. I do not propose to deal with the material in this communication, which is merely intended to notify the discovery of an extremely interesting series of fossils in South India, nor do I propose to discuss here the probable theories which have been put forward to account for such occurrence. The photograph of the mandible reproduced as Fig. 1 will give an idea of the condition in which the fossils occur in the Cretaceous area of South India. A detailed description of the material will appear soon elsewhere.

C. R. Narayan Rao.

Central College, University of Mysore,
Bangalore, June 12.

Natural Ionising Radiation and Rate of Mutation.

About a year ago there appeared in these columns a communication by A. R. Olson and G. N. Lewis on natural radioactivity and the origin of species (Nature, April 28, 1928, p. 673), in which it was suggested that the natural ionising radiation of the earth plays an important part in evolution. It was pointed out that the relative effects of rays of different frequency upon the production of variants have not been experimentally ascertained, but that since the rays can only be effective when absorbed, and thus produce ionisation, it seems safe to assume that the various rays will produce biological effects in proportion to the ionisation they cause.

It was our good fortune to discover a location in a street car tunnel in San Francisco, only 15 miles from Berkeley, where the natural ionising radiation is fully twice as great as the radiation in our laboratory in Berkeley. Accordingly, an experiment was planned for the purpose of comparing the rates of occurrence of sex-linked lethal mutations in *Drosophila melanogaster*, following a method already devised by Muller (*Genetics*, **13**, 279-357; 1928) and using a balanced lethal strain synthesised by him.

Up to the present, 5981 individual males have been tested in the first phase of the experiment. Of this number, 3481 tests were made in Berkeley, and 9, or 0·26 per cent, produced no male flies and so revealed the occurrence of new lethals, while 2500 tests were made in the tunnel, and of these 13, or 0·52 per cent, contained no male flies. The difference in rate, $0{\cdot}26 \pm 0{\cdot}11$, while only 2·5 times the probable error, may be fairly significant. When the difference in rate of mutation is computed by a method which analyses the actual experimental variation in rate in the several subgroups in each of the two series (Berkeley and San Francisco), the variation within the series is found to be less than that to be expected in random sampling, so that the significance of the difference between the average rates for the two locations is increased. This difference is $0{\cdot}275 \pm 0{\cdot}086$.

It seems fairly safe to assume, therefore, that the same difference in rate of mutation will continue throughout the remainder of the experiment, in the second phase of which an *X*-chromosome from a normal wild type strain is being tested in alternate generations. This not only doubles the scope of the experiment but also makes it possible to test such lethals as occur in this new chromosome, which it is impossible to accomplish when working with the balanced lethal strain alone.

Even now, however, it seems fairly safe to conclude that the natural ionising radiation of the earth is a very important factor controlling the rate at which

new inherited characters originate in animals and plants. While it may not be inferred from existing evidence that such radiation is the direct cause of mutation, yet a way is now open by which this question can be attacked experimentally. It is our intention to conduct a second experiment which will approximate fairly closely to the requirements of a crucial test of this important question.

E. B. BABCOCK.
J. L. COLLINS.

College of Agriculture,
University of California,
Berkeley, California.

Mammalian Life in High Latitudes.

How far seals and whales migrate north in the summer months is a moot question, but the following facts suggest that the latitude reached in the case of the floe-seal, the narwhal, and the Greenland whale is a high one.

The occurrence is recorded, in log-books of whaling vessels in my possession, that in the Greenland Sea, in lat. 80°—a situation in which, owing to the direction of the prevailing winds, the ice is usually drifting south—in May of numbers of floe-seals—seals which, as Stefansson explains in his "Friendly Arctic", are tied to sheets of ice, of moderate thickness, the product of a single winter's frost, which therefore must have drifted south from a higher latitude during the winter and early spring. For example, on May 27, 1887, lat. 79° 58′ N., long. 3° E., "got into a Floe-water; some Narwhals and many floe-seals".

The occurrence is also recorded in my father's log-books, that in the Greenland Sea, in lat. 80°, in May, large numbers of narwhals were often seen going north-east and in the direction of the high latitude in which the observers in the *Fram* saw them. Example, May 28, 1887, lat. 80° N., long. 2° E., "Numbers of Narwhales passed us during the night; all going north-east".

The Greenland whales, with the exception of a few old ones, mostly males, which in some seasons were seen off the Greenland coast in the summer months, deserted the waters between Greenland and Spitsbergen in June (in late seasons, not until July) and were not seen again by the whalers until the following spring. As Scoresby says: "It has often happened that not a single whale has been seen by any individual belonging to the whole Greenland fleet after perhaps the middle of June". They disappeared going north-west, but how far they went in that direction the whalers, being unable to follow them, never knew. Example, July 7, 1876, lat. 78° 40′ N., long. 2° W., "Saw a whale . . .; whale (the last one seen that season) making much headway to north-west".

The Greenland whale appears also to make the Arctic Ocean its usual breeding place; the fully grown whales that Scoresby speaks of seeing in latitude 80°, in the spring, which disappeared by the end of April, might quite well have been pregnant females on their way to produce their young in the Arctic Ocean. As mentioned in my letter on the "Breeding Habits of the Greenland Whale" (NATURE, April 13, 1929), Greenland whales were seldom seen in the Greenland Sea with calves with them, and then usually in the spring, in lat. 79° or 80°, on the confines of the Arctic Ocean. That they did have calves was proved beyond a doubt, as my father says, by the numbers of young whales that were frequently seen.

It seems also worth while pointing out that each of the Greenland whale's haunts communicates with the Arctic Ocean and that they migrate towards it in the spring: the whales of the Bering Sea going north through the strait of the same name, those of the Greenland Sea north through the strait between Greenland and Spitsbergen, and those of Davis Strait and Baffin Bay west through Lancaster Sound, etc. Lastly, in the Antarctic, where there is no polar ocean to which it can retreat in the summer months it is absent.

ROBERT W. GRAY.

8 Hartley Road,
Exmouth.

The Origin of Alphabets.

THE mouth gesture theory of human speech—of which a summary appeared in NATURE of Feb. 23, p. 281—has just received a further extension which may be of anthropological and psychological interest.

The basis of the main theory was:

(1) That man naturally and unconsciously tends to express his ideas in pantomime.

(2) That there is a natural and unconscious sympathy between bodily gesture—more particularly hand gestures—and movements of the mouth and tongue.

In this way, it was suggested, the primitive panto-mimic code of human expression became associated with a related code of unconscious mouth gestures which resulted in the production of the various speech sounds, and their use in the form of language.

Let us consider what might be expected to happen when—after a million years or so of speech development—man began to feel the need of a method of recording his speech. It is obvious he could not attempt to record its sounds, and *ex hypothesi* he could not directly record its gestures, for he was unconscious of them. Under these conditions it seems likely that the original sympathy between hand and mouth became once more operative, but in the reverse direction.

Man's mouth, by this time, had established a well-defined code of gestures by which his ideas could be expressed. His hand was now searching for a new form of symbolism by which to record his speech. This symbolism was one of hand gestures, which were made to leave their track on the surface of stone or bark or plastic clay; these were (still unconsciously) inspired by the mouth gestures for which they stood.

Human writing admittedly derives originally from pictographs, that is, hand gestures which outline the form of the object or motion described, but except in the case of the ideographic scripts, such as Chinese, the development of writing has tended to be largely phonetic—either syllabic or alphabetic. In other words, the system has tended to be one of hand gestures which symbolise mouth gestures.

Granting that the words for natural objects would most simply be recorded by outlining the objects themselves, as in pictography, there must have been an early need for a method of recording speech sounds *per se*. I have recently found definite evidence that in Sumerian, and still more in Greco-Roman writing, the symbolism depended largely on the principle of unconscious imitation of mouth gestures.

Thus, in the case of the Greek alphabet:

B represents an outline of the two lips of a head facing to the right; Θ is a front view of a mouth showing the tongue between the teeth; Δ is a view of the tongue raised to the palate, as in articulating the consonant D; Λ is a similar gesture, but made more lightly.

Mr. H. B. Walters, of the British Museum, whom I have consulted on the matter, agrees that nearly all the letters of the Greek alphabet show influence of

mouth gestures. I may add that more than twenty of the letters of our own alphabet still show the same influence.

The evidence on which the theory rests will be published elsewhere. R. A. S. PAGET.

1 Devonshire Terrace,
Lancaster Gate, W.2,
July 16.

Natural History and Folk-Lore.

DR. W. MALDWYN DAVIES'S reference (NATURE, July 13, p. 55) to 'gwas-y-neidr'—the Cymric equivalent of 'ether's mon'—as the name for a dragonfly reminds me that 'gwas-y-neidr' is a not unusual folk-name for the yellow-hammer, although perhaps the bird is more often called 'pen-felen' (= yellow-head). In 1914 I was at Nevin, Carnarvonshire, where a man, about forty-five years of age, asked me if I thought that the 'gwas-y-neidr' was really poisonous. He went on to explain that as boys his companions and he always smashed the eggs of the yellow-hammer if they found a nest, and that when in winter they caught small birds in his father's farm-yard, the yellow-hammers were always killed with a stick, as it was considered dangerous to touch them with a naked hand. The birds had been hatched from eggs laid by adders and the serpentine markings on the eggs in the yellow-hammers' nests were evidence of their reptilian origin; markings which elsewhere have earned for the yellow-hammer the less sinister names of 'writing master' and 'scribbling lark'.

What was substantially the same story was told by peasants and fishermen in other places in Lleyn, and since then I have met with 'gwas-y-neidr' in other parts of Wales, the bird always being associated, to its detriment, with the adder. At St. David's and at Fishguard, Pembrokeshire, the adder is by some reputed to go into the nest of the 'gwas-y-neidr'; others say that the bird carries food to the adder; and one man told me that he always destroyed the eggs in order to save them from the adder. At Newcastle Emlyn, Carmarthenshire, the 'gwas-y-neidr' is said to warn the adder by its notes of the approach of an enemy.

Dr. Davies cites 'gwas-y-gog' as a Welsh name for the hedge-sparrow. Personally, I have never heard it applied to that bird, but it is a common folk-name for the meadow-pipit, the most frequent fosterer of the cuckoo (gog) on the Welsh moorlands, where the feeding of a young cuckoo by meadow-pipits is a familiar sight in July and August. The name is a singularly apt one, by reason of the unwearying ministrations of the duped pipits which are evoked by the peremptory and incessant hunger-cries of the cuckoo.

CHAS. OLDHAM.

The Bollin, Shrublands Road,
Berkhamsted, July 23.

IN reference to Dr. R. J. Tillyard's letter in NATURE of June 1 and succeeding letters in the issues of June 15 and July 13, concerning the dragonfly's being called the 'ether's mon' or 'adder's servant', I may add that in the coal-field districts of South Wales, when I was a boy, we used to call the dragonfly the 'gwas-y-neidr', or 'servant of the snake', and the tradition was that where the dragonfly was seen above the grass, the snake would be found below.

Obviously this would be a likely event if the 'nader' (snake) were the common grass snake, which like the dragonfly frequents marshy meadows and the water-side, but if 'nader' is translated 'adder' or 'viper' in the modern scientific sense, the association of fly and snake would be accidental at best.

The fact that the tradition exists in the rather isolated valleys of the Welsh mountains and in the Welsh language in precisely the form given by Dr. Tillyard in English, suggests that the legend may be of very ancient origin. L. ROWLAND.

Second Spark Spectrum of Selenium (Se^{++}).

THE spectrum of selenium obtained by the condensed discharge is much more complicated than that of sulphur under the same condition of excitation. Of the existing data on the subject, Misserschmitt's list of lines given in vol. 6 of "Handbuch der Spectroscopie" by Kayser and Runge appears to be fairly complete, but the abundance of lines in his list and inaccurate values of their intensities were rather perplexing. Bloch's recent record of a few Se^{++} and Se^{+++} lines (*Comptes rendus*, T. 183, p. 762), and the photographs obtained in this laboratory with a prism spectrograph and a ten-foot concave grating under varying conditions of excitation, have been found to be promising in sorting out lines of Se^{+}.

Taking the structure diagram of Se^{++}, the possible transitions are

$$2N_2 \swarrow N_2N_3 \quad \leftarrow N_2O_2 \swarrow N_2O_3$$
$$\qquad\qquad \nwarrow N_2O_1 \qquad\qquad \nwarrow N_2P_1$$

By the application of the extension of the irregular doublet law given by Saha and Kichlu combined with the method of horizontal comparison described by Saha and Majumdar, *PD*, *PP*, and *PS* groups of $N_2O_1 \leftarrow N_2O_2$ were located graphically at 24000, 28000, and 28400 respectively.

Leading lines of these multiplets in the same transition are:

$$^3P_2 - {}^3D_3 = 23979 \quad (\lambda = 4169{\cdot}16)$$
$$^3P_2 - {}^3P_2 = 27482{\cdot}6 \ (\lambda = 3639{\cdot}6)$$
$$^3P_2 - {}^3S_1 = 28210{\cdot}0 \ (\lambda = 3643{\cdot}8),$$

the term differences being

$$\Delta P_{01} = 450, \ \Delta P_{12} = 949, \ \Delta D_{12} = 187, \ \Delta D_{23} = 446.$$

A full description of this analysis will appear along with that of Se^{+}. D. K. BHATTACHARJYA.

Department of Physics,
Science College, Patna,
June 19.

Spectrum of Doubly Ionised Arsenic.

THE deepest term of the separation of doubly ionised arsenic (As III) is $4p\ ^2P_1$. The values of these doublet terms relative to ^2G were reported in a recent paper (*Ind. J. Phy.*, **5**, 3, p. 3) to be 220, 221 cm.$^{-1}$. It was found in the course of this work that a number of lines that could be attributed to doubly ionised arsenic remained unclassified. The spectrum has been further investigated. About forty-five of these unclassified lines have entered into quartet systems, the terms identified being:

$5s'\ ^4P$; $5p'$ (^4P, ^4S, and ^4D) and $5d'$ (^4D and ^4F).

It is found that

$5s'$, ^4P	separations are	2133 and	1062
$5p'$, ^4P	,, ,,	1324 and	737
^4D	,, ,,	1429 and	793 and 432
and $5d'$, ^4D	,, ,,	1283	749 and 367
and ^4F	,, ,,	850	367 and 124.

A. S. RAO.
A. L. NARAYAN.

Kodaikanal Observatory.

Decay Problems in Mathematical Physics.

CONSIDER a quantity u, satisfying the equation :

$$L(u) = \rho \frac{\partial^2 u}{\partial t^2} + w \frac{\partial u}{\partial t}, \quad . \quad . \quad . \quad (1)$$

in a closed finite space, with any homogeneous boundary condition at the boundary of the aforesaid space.

Here L is a linear differential operator of the second order, extending to any number of dimensions ; for example, for three dimensions :

$$L(u) \equiv \frac{\partial}{\partial x}\left(p\frac{u}{\partial x}\right) + \frac{\partial}{\partial y}\left(p\frac{\partial u}{\partial y}\right) + \frac{\partial}{\partial t}\left(p\frac{\partial u}{\partial t}\right) - qu,$$

whereas ρ and w are finite and positive functions of the independent variables entering in L.

Then the following theorem has been proved : If a system at rest, the free motion of which is described by (1), is acted on by an oscillatory force of frequency large with respect to the lowest natural frequency of the system, until the stationary state is reached, the time of increase is directly proportional to the whole absorption and indirectly proportional to the volume, but independent of the shape of the system and of the places of the experimenter and the force. If the force, after the stationary state is reached, stops abruptly, the time of decay obeys the same law. Moreover, the increase is complementary to the decay, the sum of the amplitudes at a time t, measured from the moment the force starts in one case and from the moment the force stops in the other, being constant and independent of t.

This theorem may immediately be applied to the theory of electromagnetic radiation in closed spaces and to the acoustics of large rooms. In both cases it gives the time required by the system to reach the stationary state after a change of the radiating forces.

It has been verified experimentally by W. Sabine in the acoustics of large rooms ("Collected Papers on Acoustics", p. 39), whilst experiments by Dr. Zwikker in this laboratory have shown that the complementary nature of increase and decay really exists.

An extension, comprising absorption w, which depends on the frequency, but in a bounded and for high frequencies slowly variable way, may easily be proved.

For details reference is made to a paper, entitled : "Über das Dämpfungsproblem der mathematischen Physik", which will be published in the *Mathematische Annalen* and to a paper entitled "On the Acoustics of Large Rooms", which will appear shortly in the *Phil. Mag.*

M. STRUTT.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.

Raman Effect in Gases and Liquids.

IN a note recently communicated to NATURE it was pointed out that the Raman effect in triatomic molecules having a linear model could be explained on the assumption of a fundamental mode of vibration along the line joining the three nuclei of the molecules. Such vibrations take place along the direction of propagation of the radiation and behave as optically inactive ones and are not manifested in the near infra-red bands. The case of carbon dioxide was discussed on this basis.

The Raman effect of liquid carbon disulphide has recently been studied in Sir C. V. Raman's laboratory, and it shows two prominent modified lines due to absorption of energy corresponding to infra-red wave lengths 12·5 μ and 15·27 μ (private communication), which have so far not been observed as absorption bands. This can now be explained on the supposition of an optically inactive frequency $\nu = 728$ cm.$^{-1}$ of $\lambda = 13{\cdot}73$ μ. The two lines being due to transitions $\Delta i = \pm 1$ of the molecule (*Nat. Research Council Bull.*, **57**, p. 62) from this fundamental vibrational state.

The observations of McLennan and McLeod (NATURE, Feb. 2, 1929) regarding the Raman effect in liquid oxygen, nitrogen, and hydrogen, showing the absorption of energy corresponding to values of $\nu = 1554$ cm.$^{-1}$, $\nu = 2335$ cm.$^{-1}$, and $\nu = 4149$ cm.$^{-1}$, also suggest that the nuclei of these homopolar molecules even in the liquid state execute vibrations under impressed radiation, though no bands in these regions have so far been observed. One may thus be led to imagine that nuclear vibrations occur along the direction of propagation of the radiation and are thus optically inactive so far as absorption is concerned. Dennison (*Astro. Jour.*, **62**, 1925) calculated the fundamental frequencies of the methane molecule from dynamic considerations, and out of the four fundamental frequencies, three have been identified in the absorption bands and it has been suggested that the fourth one at $\lambda = 6{\cdot}58$ μ is optically inactive. The presence of such an optically inactive vibration is also suggested from the work of Bennet and Meyer on the spectra of methyl halides (*Phys. Rev.*, **33**, 895 ; 1929). It will be worth while to study the Raman effect of this gas to ascertain from the modified lines the presence of this fundamental frequency suggested from dynamical considerations.

P. N. GHOSH.
P. C. MAHANTI.

Applied Physics Laboratory,
University College of Science,
Calcutta, May 27.

The Raman Effect for X-rays.

IN a letter in NATURE of April 27, p. 642, we reported some experiments on the fine structure of the normal scattered molybdenum $K\alpha$-radiation. From our photometer curves it is clearly shown that the normal scattered molybdenum radiation from graphite has exactly the same structure as the direct radiation from a molybdenum target or, in other words, that no Raman effect exists. An analogous result was obtained by W. Ehrenberg (*Zeit. f. Physik*, **53**, 234 ; 1929) ; whereas B. Davis and D. P. Mitchell (*Phys. Rev.*, **32**, 331 ; 1928) obtained on the contrary a much more complicated structure in the case of the normal scattered radiation.

In the meantime the experiments were continued by D. P. Mitchell (*Phys. Rev.*, **33**, 871 ; 1929), and analogous results to those obtained with graphite are reported when beryllium and aluminium were used as scattering substances. Though for the moment we cannot explain the difference between Mitchell's results and our own, we should like to direct attention to the following fact : In the case of beryllium Mitchell finds an 'anti-Stokes line' which should be scattered by an atom in the excited L-state. Now a simple calculation shows that even when working with an energy so large as 3 kw., and such short distances as was done by Mitchell, much less than one beryllium atom in 10^{15} can be in the excited L-state. Hence it follows that it is quite impossible to account for the order of magnitude of the intensity of the anti-Stokes line quoted by Mitchell.

D. COSTER.
I. NITTA.
W. J. THIJSSEN

Natuurkundig Laboratorium der
Rijks-Universiteit,
Groningen.

Adaptation.[1]

By Prof. D. M. S. Watson, F.R.S.

THE only great generalisation which has so far come from zoological studies is that of evolution—the conception that the whole variety of animal life, and the system of inter-relationships which exists between animals and their environment, both living and non-living, have arisen by gradual change from simpler or, at any rate, different conditions.

Evolution itself is accepted by zoologists not because it has been observed to occur or is supported by logically coherent arguments, but because it does fit all the facts of taxonomy, of palæontology, and of geographical distribution, and because no alternative explanation is credible.

Whilst the fact of evolution is accepted by every biologist, the mode in which it has occurred and the mechanism by which it has been brought about are still disputable. The only two ' theories of evolution ' which have gained any general currency, those of Lamarck and of Darwin, rest on a most insecure basis ; the validity of the assumptions on which they rest has seldom been seriously examined, and they do not interest most of the younger zoologists. It is because I feel that recent advances in zoology have made possible a real investigation of these postulates that I am devoting my address to them.

Both Lamarck and Darwin based their theories on the assumption that every structure in an animal had a definite use in the animal's daily life or at some stage of its life history. They understood by adaptation a change in the structure, and by implication also in the habits of an animal, which rendered it better fitted to its " organic or inorganic conditions of life ". Thus, for Darwin at any rate, a general increase in the efficiency of an animal was an adaptation. But amongst his followers the term came to imply a definite structural change of a part or parts by which an animal became better suited to some special and characteristic mode of life. The adaptation of flowers to ensure fertilisation by definite species of insects is a characteristic case. Such definite adaptations can only be shown to exist by very long continued observation of the animal under its natural conditions of life. In the post-Darwinian literature the suggestion that such and such a structure could be used for some definite function is too often regarded as evidence that in fact it is actually so used. My colleagues amongst the palæontologists are, I am afraid, offenders in this way.

Even if it can be shown that the structure of an animal is such that it is specially fitted for the life which it in fact pursues, it does not necessarily follow that this structure has arisen as a definite adaptation to such habits. It is always conceivable, and often probable, that after the structure had arisen casually, the animal possessing it was driven to the appropriate mode of life.

The only cases in which we can be certain that adaptation in this true sense has occurred are those, unfortunately rare, in which we can trace in fossil material the history of a phylogenetic series, and at the same time establish that throughout the period of development of the adaptation its members lived under similar conditions.

It is not unusual for a student of fossils to discuss the habits of an extinct animal on the basis of a structural resemblance of its ' adaptive features ' to those of a living animal and then to pass on to make use of his conclusions as if they were facts in the discussion of an evolutionary history or of the mode of origin of a series of sediments.

In extreme cases such evidence may be absolutely reliable : no man faced with an ichthyosaur so perfectly preserved that the outlines of its fins are visible can possibly doubt that it is an aquatic animal, and such a conclusion based on structure is supported by the entire absence of ichthyosaurs in continental deposits of appropriate ages and their abundance in marine beds. But if extremes give good evidence, ordinary cases are always disputable. For example, there is, so far as I know, not the least evidence in the post-cranial skeleton that the hippopotamus is aquatic : its limbs show no swimming modification whatsoever, and the dorsal position of the eyes would be a small point on which to base assumptions.

Most palæontologists believe that the dentition of a mammal, and by inference also that of a reptile or fish, is highly adaptive, that its character will be closely correlated with the animal's food, and that from it the habits of an extinct animal can be inferred with safety.

Here again the extreme cases are justified ; the flesh-eating teeth of a cat and the grinding battery of the horse are clearly related to diet. Crushing dentitions, with the modification of skull and jaw shape and of musculature which go with them, seem equally characteristic. I had always believed that the horny plates and the jaws of the platypus were adapted to hard food, and that that animal possessed them, whilst the closely allied *Echidna* was toothless, because it was aquatic and lived in rivers which might be expected to have a rich molluscan fauna that could serve as food. But the half-dozen specimens the stomachs of which I have opened contained no molluscs whatsoever, and seem to have fed on insect larvæ, the ordinary soft bottom fauna of a stream. I do not know whether this is an accidental occurrence, dependent on a special abundance of insects in the Fish River in late spring, or whether it really represents the normal food. Nothing but continued observations made throughout the year can justify any statements about this case.

In the face of this uncertainty, can we make use of the character of the dentition of fossil vertebrates for the determination of the nature of their food, and thus by building up phylogenetic series investigate the gradual development both of habit and their adaptation ? One without the other is valueless. The classical case of the horse is, of course,

[1] From the presidential address to Section D (Zoology) of the British Association, delivered at Johannesburg on Aug. 2.

familiar to everyone. From the time of Huxley the story of the gradual increase in depth of crown of the molar teeth and in the complexity of the pattern formed by the worn edge of the enamel which coats the cusps of the molars has been held to show a steady improvement in mechanism which enabled the Equidæ to take advantage of a wide extension of grass land which was assumed to have occurred in Miocene times.

This assumption in its ordinary form, however, rests on the basis of an inadequate analysis of all the factors involved. The modern horses are bigger than those of the Eocene: an ordinary hackney weighs about fifty times as much as *Eohippus venticolus*. Thus, the modern horse will wear away in a day fifty times as much tooth as its ancestor; but the surface area of its cheek teeth is only about fifteen times as great, so that without a deepening of the tooth crown by three and a third times it would have a shorter life. Actually the crown is deepened about thirteen times, so that its potential longevity is increased to about four times that of *Eohippus* on the assumption that the abrasive qualities of the food of the two animals have not changed. Dr. Matthew has produced evidence to show that in *Merychippus*, the Miocene genus of horse, tooth change took place at a younger age than it does in modern horses; the implication being that the potential longevity was less than it now is.

Thus the fact that *Equus* has proportionately some four times as much tooth as *Eohippus* may mean no more than that it lives longer, and its marvellous dentition may not be adaptive in the sense that it is specially modified for the trituration of a new type of food. It may represent no more than a reaction to the requirements of a large animal. I believe that most adaptations the history of which can be traced in fossil material are of a similar kind.

Whether a change which enables a mammal to become larger and to have a greater potential longevity is an adaptation may be disputed. Certainly it is very different from the usual conception of a structural change fitting an animal for a definite type of life in particular circumstances.

There are, however, a few cases where we are, I think, on firmer ground. The slow and steady improvements in limb structure which go on in the mammal-like reptiles from Lower Permian to Lower Triassic times take place in animals which do not exhibit a steady increase in size, which indeed cover nearly the same range of sizes at the beginning and end of the story.

In the earliest of these animals the upper arm projected at right angles to the body, and the forearm lay at right angles to it, nearly parallel to the ground. The track was very wide, the stride absurdly short, and only one foot could be moved at a time, whilst some of the muscles were devoted entirely to the support of the weight of the body, leaving the whole propulsive force to be supplied by the remainder, or rather by such of them as were not concerned with returning the limb to the position it occupied at the beginning of the stride. From these slow and clumsy ancestors we may trace the gradual acquirement of the structure found in *Cynognathus* or in a mammal; where the arm moves nearly parallel to the principal plane of the animal, the stride is greatly lengthened and every muscle contributes both to the support of the body and to its propulsion. Here we have a case where we can observe an improvement of an animal mechanism which definitely enabled an animal to move faster than its ancestor.

Such general improvements in the mechanism of an animal's body, which are the only adaptations which can be proved to have occurred, differ so greatly in scale and in their general nature from that detailed fitting of an animal to some particular niche in its environment which Darwin believed to occur, that it is important to investigate whether there is any general occurrence of such special relationship of structure and habit, and whether if it occurs it is rightly to be regarded as of adaptive origin. It is, I believe, in the first part of such investigation that a good deal of the future value of physiological work in zoology lies.

The physiological work which is at present being conducted by zoologists falls under two main heads. It may be concerned with the explanation in physico-chemical terms of definite life processes, such as fertilisation or cleavage, the activities of cilia or the nature of muscular activity. Such work is of value to zoology because it increases our knowledge of the cell and all its parts and of the things which may control its activities. It will become essential for an understanding of the factors which underlie morphogenesis, that is, of those factors some of which are carried as material bodies in the chromosomes.

The other type of physiological work is that which, like the classical 'experimental physiology' of the medical school, is devoted to an attempt to understand the functioning of the different systems of organs and ultimately of the whole body of an animal. I believe that such studies hold out the greatest promise of results of any in zoology. We do not know even as a first approximate the mode of working of the body of any one member of the majority of the phyla of the animal kingdom. Until such is known, in at least a few individual species of each phylum, we shall not be in a position to understand the possibilities of adaptation which each fundamental type of morphology holds out and the real significance of the fitting of an animal to its environment.

The ecological relationships of animals to their environments present many aspects which are now capable of investigation by simple physiological experiment, and South Africa seems to me the country of all others which could provide the subjects for such an investigation.

Physiological work of the kind which I suggest, although it will show to what extent there are variations between races and species of animals which fit them specially for life under definite physical environments, will not in general elucidate those morphological differences which alone are recognisable in a museum, and have commonly been assumed to be of an adaptive nature. That these structural

differences are adaptive even in the sense that, no matter in what circumstances they arose, they do now in fact fit each form especially to its circumstances, is for the most part pure assumption. I do not know a single case in which it has been shown that the differences which separate two races of a mammalian species from one another have the slightest adaptive significance.

There is no branch of zoology in which assumption has played a greater, or evidence a less, part than in the study of such presumed adaptations. The implication which lies behind any statement that such and such a structure is an adaptation is that under the existing environmental conditions an individual possessing it has a greater chance of survival than one which has not.

The extraordinary lack of evidence to show that the incidence of death under natural conditions is controlled by small differences of the kind which separate species from one another or, what is the same thing from an observational point of view, by physiological differences correlated with such structural features, renders it difficult to appeal to natural selection as the main or indeed an important factor in bringing about the evolutionary changes which we know to have occurred. It may be important, it may indeed be the principle which overrides all others ; but at present its real existence as a phenomenon rests on an extremely slender basis.

The extreme difficulty of obtaining the necessary data for any quantitative estimation of the efficiency of natural selection makes it seem probable that this theory will be re-established, if it be so, by the collapse of alternative explanations which are more easily attacked by observation and experiment. If so, it will present a parallel to the theory of evolution itself, a theory universally accepted not because it can be proved by logically coherent evidence to be true but because the only alternative, special creation, is clearly incredible.

The alternative explanations which are put forward of the existence of the differences which separate species from species or one geographical race from another are in essence three : either the difference is regarded as adaptive and its initiation and perfectioning are attributed to a reaction of the animal which alters its structure in a favourable manner followed by an inheritance of the character so acquired ; or, secondly, it is regarded as non-adaptive, or only accidentally of value, and held to have arisen by a change induced in the course of an individual development by the direct effect of some one or more environmental features, such change not necessarily being heritable in all cases. The third explanation is that the difference between one form and the other has arisen casually, isolation having enforced an inbreeding which led to the distribution of genes in different proportions in the two stocks.

The first alternative explanation suffers from the defect that the characters in question have not in general been shown to be adaptive, and that an inheritance of an acquired character of the kind required has not been shown to occur.

The second explanation, the direct influence of the environment, has the immense advantage that it is open to investigation by experimental methods, and suggests many attractive lines of work. Here again experiments have been few. The most successful is that on the induction of melanism in moths by Heslop Harrison and Garrett. By feeding caterpillars on food impregnated by salts of manganese or lead, these authors, in three independent series of experiments, obtained melanic individuals of a character which did not occur in the much larger numbers of controls fed on untreated food, nor under natural conditions in the district of origin of the parent individuals.

Harrison and Garrett attribute the melanism which appeared under these conditions to the direct effect of the metallic salts, either on the soma or, as is perhaps more probable, on the germ cells. They showed by a very adequate series of breeding experiments that the melanism which arose in this way is inherited as a simple Mendelian recessive.

It is obvious that such a direct environment effect, when taken in association with the completely established fact of the common occurrence of parallel or identical mutations in allied animals, provides a complete formal explanation of such facts as that the coat-colour of a race of a species of rodent from an arid region will in general be lighter in colour than that of a race from a more humid and therefore more thickly vegetated area. It is clear that such an explanation does not require that the coat-colour has any adaptive significance whatsoever : it is in complete contrast with the equally formally complete explanation by natural selection. But it has the advantage that it can be submitted to experimental confirmation.

The neo-Darwinian would explain this occurrence by assuming that the dark-coloured forms were less visible against the moist and therefore darker soil of the humid locality than lighter animals would be, and would thus escape the attacks of carnivores for a longer period. The light forms would escape notice under the bright illumination and glitter of an arid and especially a desert country. Such a view assumes without question that the colour of the two groups is heritable, though it makes no demands for any particular type of heredity.

The only experiments which have been made with geographical races of mammals are those which Sumner has carried on over many years. Sumner began his work by collecting considerable numbers of individuals of a certain species of the deer-footed mouse *Peromyscus* from localities in California which present extreme variations in rainfall and temperature. He showed that the mice from each locality varied, and that the distribution of the variates for each character formed a unimodal curve. He investigated by statistical methods the correlation between pairs of the characters with which he worked, showing that for many of them the correlation was small. He showed that the curves for different subspecies might overlap, so that no one individual could fairly represent its race.

Sumner also attempted to investigate the possibility of such environmental influences by direct experiment. He transplanted a small colony of

mice into a very different environment, enclosing them in a small netted area and leaving them to breed. The offspring which appeared during the course of the experiment showed no tendency to approach the local races in their characters.

It may be accepted as a working hypothesis that the variable characters which separate one geographical race from another are produced under the influence of a number of genes, all independent, and all producing similar effects. As Prof. Karl Pearson pointed out in 1904, the effect of such multiple factors will be to produce an apparent blending inheritance ; a view now very generally accepted. It follows that, in certain cases at any rate, if a small group of individuals phenotypically similar, though genotypically different, differing from the norm of a population, be isolated and left to breed freely, they will, when considered as a population, tend to vary still more from the original mode in the population from which they sprang and that they will do so in the direction in which the original isolated group differed. Prof. Pearson has reached the same conclusion from his own very different point of view and has evidence that the expected result does actually occur.

If, then, we can conceive of circumstances which will bring about such isolation in such a way that the individuals so separated are determined by an environmental condition, we shall have an explanation of the divergence of local races which will account for the appearance in them of individuals which lie outside the range of variation actually observed in the small samples of the parent races which have been investigated.

There remains one type of adaptation which is perhaps of greater importance than those which we have been considering. Perhaps the most striking of all the phenomena of life is the power which all animals and plants possess of so regulating their functioning, and when necessary their morphology, that their life is continued in equilibrium with the conditions under which they find themselves.

How far such physiological adaptations are of the same nature as those internal morphological adaptations which alter the relative sizes of parts in ways determined by geometrical considerations of squares and cubes, and produce analogous modifications in other structural features, there is no evidence. What is certain, however, is that these, which are the fundamental things in evolution, lie open to experiment.

Thus the present position of zoology is unsatisfactory. We know as surely as we ever shall that evolution has occurred ; but we do not know how this evolution has been brought about. The data which we have accumulated are inadequate, not in quantity but in their character, to allow us to determine which, if any, of the proposed explanations is a *vera causa*. But it appears that the experimental method rightly used will in the end give us, if not the solution of our problem, at least the power of analysing it and isolating the various factors which enter into it.

The Relation of Organic Chemistry to Biology.[1]

By Prof. GEORGE BARGER, F.R.S.

SINCE, in the last resort, we are dependent on naturally occurring materials, which scarcely ever occur in a state of purity, it follows that the early chemists were even more concerned with separating one substance from another than many of us are to-day. Progress was at first limited to mineral substances capable of withstanding powerful reagents and a high temperature ; much of the old chemistry is concerned with the heavy metals. The substances formed in such large numbers by living beings are much less stable, and their isolation demands a special technique. It is significant that, in spite of their knowledge of the smelting of ores, of the manufacture of glass, and of many other arts, the ancients failed to distil alcohol. Later, the chemical investigation of organic material was apt to consist in destructive distillation, naturally adding little to knowledge. Only the more volatile and stable substances could be isolated in this fashion.

An important systematic advance was made by K. W. Scheele (1742–1786), whose contributions to organic chemistry are almost as important as his discovery of oxygen. Scheele was a pharmacist, and most of the early chemists were trained as such, or as physicians, from the iatro-chemical period onwards. This old connexion between chemistry and medicine was, however, scarcely a biological one. Joseph Black's work on fixed air and the mild alkalis indeed originated in medicine, from his M.D. dissertation, "De humore acido a cibis orto et magnesia alba", but the subsequent developments of Black's work were not biological in character. Again, although Berzelius was trained as a physician, his work had little connexion with biology.

The use of vegetable drugs, however, led pharmacists to examine the constituents of plants, and thus the foundations of descriptive biochemistry were laid. Scheele investigated a number of organic acids in the wet way. He obtained tartaric acid in 1769, and later benzoic acid by boiling gum benzoin with lime. He first prepared lactic acid (1780) from sour milk, and mucic acid by oxidation of milk sugar. When, soon afterwards, mucic acid was also obtained from gum tragacanth, it became evident that one and the same substance may be derived from both animal and vegetable sources. Oxalic acid was obtained from the acid potassium salt in *Oxalis acetosella*, and shown to be identical with an oxidation product of cane sugar. Scheele also obtained citric, malic, and even gallic acid by crystallisation from solution. Of more general biological interest is his discovery of uric acid, of glycerol, and of hydrocyanic acid ; the last (acidum berolinense) by heating potassium ferrocyanide with dilute sulphuric acid.

[1] From the presidential address to Section B (Chemistry) of the British Association, delivered at Cape Town on July 23.

Scheele's discovery that esterification is greatly furthered by the presence of mineral acids later became important in connexion with catalysis, but theoretical speculations were foreign to his nature, and he was not greatly concerned with the essential character of acids. Such questions appealed more strongly to Lavoisier, who improved the nomenclature of organic acids and also investigated alcoholic fermentation, a biochemical process which early engaged the attention of chemists.

A knowledge of structure gave a great impetus to organic synthesis, not only in the laboratory for theoretical purposes, but also in the factory for practical uses; the manufacture of dyes, of synthetic drugs, of explosives became an important industry. The number of known carbon compounds grew at an enormous rate. Instead of being the chemistry of organised beings, organic chemistry became the chemistry of carbon compounds. Until the present century the proportion of chemists who, like Scheele, were interested in natural products steadily declined, and biology became of little interest to chemists as a whole, but physiologists have more and more realised the importance of chemistry for their subject and the intermediate subject of biochemistry has rapidly developed.

The systematic study of natural products, inaugurated by Scheele, was at first continued most successfully in France by Fourcroy, Vauquelin, and their pupils. Braconnet examined plants and discovered substances such as salicin and ellagic acid, of no particular importance to physiology, but also obtained glucose from cellulose (linen) and 'sucre de gélatine' or glycine from glue, thus making two fundamental observations in biochemistry. Kirchhoff, a German pharmacist, working at St. Petersburg, had already shown in 1811 that glucose is formed from starch, and investigated the process of malting. In 1833, Payen and Persoz discovered the first enzyme, diastase, and in 1827 a medical practitioner of London, W. Prout, better known to chemists in another connexion, could say in a paper "On the ultimate composition of simple alimentary substances" that they might be arranged in three classes, "the saccharine, the oily, and the albuminous".

By analysis Gay-Lussac was able to establish the fundamental equation for the fermentation of glucose into alcohol and carbon dioxide, and the first systematic advance in biochemistry, also due to analysis, was Chevreul's great work on the fats. In 1824, Wöhler obtained oxalic acid from cyanogen, the first synthesis of a vital product, if we except Scheele's production of cyanides from carbon, potassium carbonate, and ammonium chloride. Four years later, in 1828, Wöhler's synthesis of urea attracted universal attention, and since then much labour has been expended on the synthesis of vital products as an ultimate proof of their structure.

Wöhler had apparently no connexion with medicine or pharmacy, but Liebig was a pharmaceutical apprentice for one year, Frankland a druggist's assistant, Dumas, Schorlemmer, and even Wilhelmy, who investigated the kinetics of sugar hydrolysis, were pharmacists. Gmelin, Mitscherlich, Wurtz, and Cannizzaro studied medicine; even in the present century medically qualified professors of general chemistry survived (Crum Brown, Emerson Reynolds). The pharmacists soon found a special field of research in alkaloids, essential oils, and other products of the materia medica. Within a few years of the recognition of the first organic base, morphine, by the German pharmacist Sertürner, a dozen alkaloids had been discovered, mostly in France, by Pelletier and Caventou, professors at the École de Pharmacie. It is presumably due to this institution, and to the high standard of pharmaceutical education in France, that the scientific output of French pharmacists has been so long maintained. For recent times we may refer to Bourquelot, professor at the École de Pharmacie, and to Charles and Georges Tanret, father and son, both practical pharmacists, who not only made important contributions to our knowledge of drugs but also to that of sugars. In Germany contributions of pharmacists to organic chemistry were of less importance, compared with the great developments in university research inaugurated by Liebig and fostered by the German States.

In Britain the State did very little for the universities and nothing for pharmaceutical teaching; although British pharmacists have the exclusive legal right to call themselves 'chemists', the State has not helped them to justify the title. At first the British themselves contributed little to organic chemistry; of the pioneers Faraday, Frankland, Perkin, and Williamson, only two were teachers. The sojourn of Hofmann in London, from 1845 to 1865, from the age of twenty-seven to that of forty-seven, was of the greatest influence on the development of organic chemistry in England, but it did not lead to biological applications. Particularly through the inauguration of the dye industry, by Hofmann's pupil, Perkin, and Mansfield, attention was directed to practical problems.

As a result of Emil Fischer's work, the new science of biochemistry was firmly established in the beginning of the present century. It should not be supposed that organic chemical theory is wholly unconnected with biology. Two examples out of many will show the contrary. When a protein is 'racemised' so far as possible, by Kossel's method, by leaving it for some weeks at 37° in half-normal alkali, it is found that certain amino-acids retain their optical activity, and these Dakin has assumed to be the ones with free carboxyl groups, situated at the ends of chains. The others undergo racemisation probably because in their case tautomerism is possible:

$$\begin{array}{l}\text{—CO . NH . CR′H . CO . NH . CR″H . COOH}\\ \qquad\qquad\qquad\qquad\qquad\qquad\uparrow\downarrow\\ \text{—CO . NH . CR′ : COH . NH . CR″H . COOH.}\end{array}$$

On subsequent acid hydrolysis the amino-acid NH_2 . CR′H . COOH would be racemic, but NH_2 . CR″H . COOH optically active. Dakin's views were first applied by Dudley and Woodman to show a structural difference between the caseinogens from cow's milk and sheep's milk, which had been considered by some to be identical.

Elementary analysis shows no difference, and individual amino-acids are obtained in the same amounts after hydrolysis. After racemisation, however, Dudley and Woodman found the tyrosine from cow's caseinogen to be wholly inactive, that from the sheep fully active. In the former animal the tyrosine is probably inside the molecule, in the latter it is on the periphery. We are thus able to discover differences in the intimate pattern of the molecule. Dakin and Dale connected these differences with antigenic specificity.

Crystallised albumins from the whites of hens' and ducks' eggs are very similar and seem to be composed of the same units in equal amounts, but Dakin found that three amino-acids, leucine, aspartic acid, and histidine, behave differently to alkali in the two molecules, and appear to occupy different places. Hen's albumin has some aspartic acid but no leucine or histidine on the periphery; duck's albumin, on the other hand, has no aspartic acid, but some leucine and histidine on the outside of the molecule. By the very sensitive anaphylactic reaction of the isolated guinea-pig's uterus, Dale showed that the two proteins are specifically different as antigens. Differences in arrangement, even of the same amino-acids, help to differentiate the proteins of various species. It is on the diversity of the proteins that the difference of species is based.

Another recent example of the application of organic chemical theory to biology is due to Stedman. Having traced the miotic action of physostigmine to a urethane grouping, he synthesised a number of urethanes of simple dimethylaminophenols, for example, $R.NH.CO.O.C_2H_4.N(CH_3)_2$. The physiological activities of the tertiary bases is generally in the order ortho and para > meta, but on conversion into quarternary salts the ortho and para become less active, the meta more so, and the order is meta > ortho or para. This recalls the reactivities of disubstituted benzene derivatives, which have of late been studied in connexion with the polarity theory.

Whilst organic chemists are often eager to investigate the constitution of animal and vegetable substances, they are less ready to undertake the preliminaries of purification and isolation, and are therefore less apt to discover new ones. By esterification and by the use of a high vacuum, Emil Fischer made the monoamino-acids amenable to fractional distillation, a standard operation of organic chemistry. He discovered several new members of the group. But most substances of physiological interest require a special technique, on the development of which the biochemist may spend much labour. Thus Kossel showed how to separate the purine and pyrimidine bases of the cell nucleus, and the important diamino-acids histidine, arginine, and lysine. Hopkins, by his special reagent, was able to isolate tryptophane, the parent substance of indigo, long after indigo itself was being manufactured synthetically. Dakin found that monoamino-acids can be extracted from aqueous solution by butyl alcohol, and using this new technique and Foreman's method of separating aspartic and glutamic acids by their calcium salts, Dakin discovered hydroxyglutamic acid, an entirely unsuspected unit of protein.

A knowledge of the structure of amino-acids may throw light on how other nitrogenous constituents arise, particularly in plants. As an example the most recently discovered amino-acid may be quoted. The American bacteriologist Mueller found in casein and other proteins a new constituent containing sulphur, quite different from the well-known cystine. Dr. Coyne and I have recently established its constitution by synthesis. It turns out to be γ-methylthiol-α-amino-*n*-butyric acid, $CH_3.S.CH_2.CH(NH_2)COOH$, and we named it methionine. The methylthiol grouping at once indicates that it is the source of methylmercaptan, the occurrence of which in putrefaction was known although not hitherto intelligible. Methionine is evidently also the parent substance of cheirolin, occurring in the seeds of the wallflower and of other Cruciferæ. Schneider had long ago established for this substance the remarkable constitution $CH_3.SO_2.CH_2.CH_2.CH_2.N.CS$. We now see at once that cheirolin is the thiocarbimide of oxidised and decarboxylated methionine. Similarly Perkin and Robinson connected the chemistry of harmine and harmaline with tryptophane when they showed that the mysterious base $C_{12}H_{10}N_2$, which Hopkins and Cole obtained by oxidising tryptophane $C_{11}H_{12}O_2N_2$, with ferric chloride, is identical with harman. This observation not only settled the constitution of the alkaloids in question, but also explained the fitful yield of the oxidation product of tryptophane, which, after decarboxylation, had condensed with acetaldehyde.

Soon afterwards, Späth showed that harman itself occurs in Nature, as the alkaloid aribine which had been given the erroneous formula $C_{23}H_{20}N_4$. It is becoming increasingly evident that many alkaloids arise by condensation of amino-acid residues. Mezcaline and other alkaloids of Cactaceæ are closely connected with phenylalanine and tyrosine, as Späth has shown, and the mode of origin of *iso*quinoline alkaloids from aromatic amino-acids has also become clear. Harmine, harmaline, physostigmine, and rutæcarpine are all derived from tryptophane, and it looks as if the same is true of other alkaloids the constitution of which, like that of strychnine and of brucine, remains obscure.

The isolation of some natural substances, of great physiological interest, is beset with difficulties because they are present in minute amount and have not the convenient solubility relations which facilitate the separation of the alkaloids. This applies to the hormones present in animal tissues. Here the American slaughter-houses provide valuable facilities, and it is significant that adrenaline, thyroxine, and insulin were first crystallised in America, although the constitution of the two former hormones was later established in Europe where also their synthesis was effected, that of thyroxine only a few years ago, through the brilliant work of Harington.

The difficulty of isolating vitamins is still more formidable; in the case of the antineuritic vitamin B, which is almost certainly a fairly simple sub-

stance, susceptible to attack by the methods of organic chemistry, much progress towards isolation has been achieved by selective adsorption and elution, the methods employed by Willstätter for enzymes. The discovery by Rosenheim and Windaus that vitamin D is formed by the irradiation of ergosterol has suddenly brought into prominence a substance which before was but a curiosity, chiefly known through the work of the French pharmacist, Tanret. At the same time the interest of biochemists in photochemistry has been stimulated, as well as in the extensive work of Windaus on the structure of cholesterol, which the latter had already shown to be connected with the bile acids, largely investigated by Wieland.

The sudden emergence of ergosterol into prominence does not stand alone; another of Tanret's ergot substances, ergothioneine, at first also an isolated curiosity, has acquired more general significance because it has been found in mammalian red corpuscles; it is likely that this will lead ultimately to the discovery in proteins of yet another sulphur-containing amino-acid, possibly a thiolhistidine. Altogether, ergot has yielded more substances of general biological interest than any other single plant.

The above examples of the relation between biological and organic chemical work relate to that division of biochemistry which may be termed descriptive. A knowledge of structure is also necessary in dynamic biochemistry, the study of the transformations which substances undergo in the living organism. The recognition of the fats as esters, and their behaviour to fat-splitting enzymes, the transformation of starch into sugar under the influence of diastase, the end-products of alcoholic fermentation; all these were early discoveries in dynamic biochemistry.

Just as the organic chemist may wish to know the mechanism of a reaction, for example of the Skraup synthesis of quinoline, so the biochemist wishes to know the intermediate steps in the transformation of, say, glucose into alcohol. The detection of these stages of metabolism is a matter of considerable difficulty, since under normal conditions the intermediate substances generally disappear as rapidly as they are formed. They have to be trapped by suitable means, as did Neuberg with acetaldehyde in alcoholic fermentation, or the metabolic process may sometimes be cut short, by using an isolated organ, such as the surviving liver, or the precursor of the intermediate substance may be administered in large excess.

Very little has been learned in this respect from the higher plants. The very process of photosynthesis is still beset with obscurity in spite of a plausible hypothesis; we know next to nothing about transformation of carbohydrate into fats, and vice versa, and in particular we are ignorant of the stages by which amino-acids are formed in plants from nitrates and carbohydrates; we simply do not know how the proteins of living beings originate. Nor have the higher plants given us much information of the way in which their fats, carbohydrates, and proteins are ultimately broken down.

Our knowledge of catabolism is principally derived from the animal world. It is found that the breakdown does not always occur in the manner in which the organic chemist would expect. Thus an organic chemist presented with the problem of transforming stearic acid into palmitic might brominate in the alpha position, and break down the corresponding α-hydroxy acid; or he might do a Hofmann degradation on the amide. In either case he would get an acid with 17 carbon atoms, and have to repeat the degradation in order to obtain palmitic acid. Knoop has shown, however, that in the animal organism the β-carbon atom is attacked so that the chain is shortened by two carbon atoms at a time, an acid with 18 carbon atoms being converted successively into one with 16, 14, 12, etc. In accordance with this scheme the principal fatty acids in Nature are those with an even number of carbon atoms. Knoop established this by feeding ω-phenyl fatty acids; those with an even number of methylene groups in the side chain were converted into benzoic acid and appeared in the urine as hippuric, those with an odd number of methylene groups yielded phenylacetic acid and were excreted as phenaceturic acid. Instead of using a resistant phenyl group and the whole animal, fatty acids themselves and the isolated liver may be used to establish the same result.

The degradation of amino-acids in the body also proceeds contrary to the expectations of the organic chemist. If he were asked to bring about the degradation by gentle stages he would doubtless first convert the α-amino into the α-hydroxy acid. The organism forms the α-keto acid, however, as shown by Neubauer and by Knoop. This biochemical result suggested to Knoop an interesting and unlooked-for synthesis of amino-acids *in vitro*, by reversing the normal breakdown. He shook solutions of α-keto acids, containing also ammonia and platinum black, in a hydrogen atmosphere, when the corresponding amino-acid resulted by the reduction of the hypothetical imino-compound. The transformation of tryptophane into kynurenic acid may be quoted as a particular problem of metabolism to which a good deal of organic chemistry has been applied.

The first stage in the degradation of fatty acids and of amino-acids seems pretty well established, and analogies *in vitro* have been found. Other problems are more obscure. Why is the benzene nucleus in phenylalanine oxidised, but not that in benzoic acid? What is the mechanism in the former case? Why is *p*-hydroxyphenylpyruvic acid easily oxidised and the corresponding lactic acid not? Why is *d*-phenylglycine easily oxidised and *l*-phenylglycine excreted almost unchanged? Altogether, the processes by which organic substances are burnt to carbon dioxide and water, by atmospheric molecular oxygen, at a low temperature, are still very puzzling, although Dakin, Hopkins, Knoop, Warburg, Wieland, and others have done much towards their elucidation. In the study of the chemical processes, as in that of the chemical constituents of living organisms, there is much scope for the application of organic chemistry,

and in addition, physical chemistry requires to be utilised.

Probably the most extensive attempt to use chemical constituents for botanical classification has been made by R. T. Baker and H. G. Smith, in the case of the Australian genus *Eucalyptus* with about two hundred species : the essential oils from well over half of these have been examined. Baker and Smith trace a relation between the venation of the mature leaves and the composition of their essential oil. The genus is thus divided into fairly well-marked groups, and it is possible to suggest the probable constituents of the oil of a given species by examining the venation of the leaves, and, conversely, by chemical investigation of the oil to gain a clue to the species. Maiden, the botanical expert on *Eucalyptus*, did not always agree with the classification of the chemists, but upon occasion he discovered morphological differences after a delimitation of species had been proposed on chemical grounds.

The main biological interest of alkaloids is not botanical in their distribution, but pharmacological in their action. This leads to a mention of the great developments in synthetic drugs, due to organic chemistry. In particular there is great scope for the organic chemist in chemotherapy, the combating of general infections of the host by synthetic drugs. The production of salvarsan, which has made such a great change to the treatment of syphilis and other protozoal diseases, and the subsequent introduction of germanin (or Baye 205) in the treatment of sleeping sickness, indicat great possibilities of applying organic chemistr to this particular department of medicine, an constitute a link between workers in very differen fields.

I have directed attention to the many points o contact between organic chemistry and biology in the past and present, and if finally I am permitte to draw a conclusion it would be an educational one I hold it to be desirable that biologists should hav at least an elementary knowledge of organi chemistry, in spite of the difficulties imposed b ever-increasing specialisation in science. Thes difficulties are particularly felt in apportioning th time available for medical education among th many subjects of a crowded curriculum, and ma to some extent be met by a careful consideratio of what is really useful.

The chemical training of the physician (and o the biologist) should not be identical with th preliminary training of the professional chemist although it still is so in many universities. I order to save time, much elementary chemistry particularly inorganic, must be abandoned, thu making room for those aspects of the subject whic have biological applications. This differentiatio between the chemical needs of various groups o students requires special courses, and teachers wh have a sympathetic understanding of the peculia needs of their students, medical and biological.

Obituary.

Prof. Charles Moureu.

NOT only the French but also chemists generally suffer a specially severe loss by the death of Charles Moureu, professor of organic chemistry in the Collége de France, the second to succeed Berthelot. In France, the leader in his subject, he was not merely a chemist of great achievement and high repute but also a man of outstanding personal character and social distinction. During the War he rendered inestimable service to his country by organising and directing the work—defensive and offensive—of the French chemists ; in this connexion he was brought into close contact with our English workers. Since then he has been a familiar figure in England.

At the close of the War, Moureu entered upon a vigorous campaign in which he made clear to politicians and the public the importance of chemistry in the modern State and the great need of improving the status and financial position of the French scientific schools. His efforts to this end were in large measure successful. His success was in no slight degree due to the eloquence with which he stated his case in his book " La Chimie et la Guerre ". Known throughout the world of chemistry, a shrewd man of affairs, a polished diplomat, in fact, Moureu was particularly endeared to the chemists of other nationalities, who met him during recent years at various international conferences, by his engaging manner and the obvious sincerity and breadth of his outlook. The thesis developed in his book is that stated by hi countryman Duclaux, which he quotes : " L chimie est au fond de tout et rien ne lui échappe " He expressed what to him was a profound truth when he said : " Le Français le plus illettré a l sentiment, net ou confus, que sa patrie est grand et belle entre toutes. Fier, sans arrogance, d'êtr Français, il est profondement patriote." Patrioti to the core, at the same time he was so scientific ally minded, so sane in his judgments, that he wa not only willing but also able to deal with inter national problems broadly and dispassionately. H was the first president of the International Unio of Pure and Applied Chemistry and contribute greatly to the foundation of the Union. At th conference at the Hague last summer, he rendere most important service in the very difficult dis cussion on the constitution of the Union whic occupied the meeting.

Moureu was a son of the mountains, a native o the Basque region. He was born on April 19, 186 at Moureux, a village in the Bearnese country, i which his family had lived during centuries ; h died at Biarritz on June 13. An eloquent funera discourse was delivered there, by his colleague an friend, Prof. Camille Matignon, on June 17 ; h was buried the following day at Oberon, in th Basses Pyrénées. The youngest of a large family his father having died while he was an infant, h was cared for by an elder brother, Félix Moureu who lavished upon him the affection of a fathe

n affection which, throughout his life, he fully eciprocated. Félix Moureu died only last year, at ie age of seventy-eight. He was a pharmacist f distinction in Biarritz, ten years Mayor of the own; he did much to develop its attractions. harles Moureu's early training was in his brother's harmacy at Biarritz. In Paris, he quickly passed rough the courses in pharmacy and those at the orbonne. He qualified as pharmacist, in the first ass, in 1891. After serving, during several years, s chief assistant, he was admitted to the Faculty f Pharmacy in 1899 and became professor of harmaceutical chemistry in 1907. Ten years later e succeeded Jüngfleisch, Berthelot's successor in ie chair of chemistry at the Collége de France. Ie also became Director of the Verdun Agricultural esearch Station, founded by Berthelot. He was lected into the Academy of Medicine in 1907 and nto the Academy of Sciences in 1911. During iore than thirty years he has been a prolific worker.

Moureu began by studying various vegetable ssences, eugenol, etc. He also worked on alka- oids, determining the constitution of sparteine. ollowing the Berthelot tradition, he devoted him- elf to synthetic studies in the acetylene series. His iost noteworthy discovery is that of the *red ydrocarbon*, rubrene, which is remarkable on ccount of the way in which it simulates the ehaviour of hæmoglobin towards oxygen, absorb- ng the gas with avidity, *when irradiated*, forming a olourless peroxide from which the oxygen may be emoved by exposure in a vacuum. If heated, at emperatures below 140°, this gives off oxygen lone, to within 80 per cent of the theoretical mount. Even at ordinary temperatures, if ex- osed to light but not in the dark, the peroxide issociates reversibly, the dissociation pressure at 6° being of the order of 0·5 cm. of mercury. ight is emitted during the deoxidation. If the ydrocarbon be subjected to oxygen in admixture ith either benzaldehyde or propionic aldehyde nly the rubrene absorbs the gas; its oxidation s retarded by quinol and other anti-oxidants; it is ot oxidised at all in the presence of carbonic oxide. Ioureu has suggested, in view of the behaviour of ubrene towards oxygen, that in oxyhæmoglobin he oxygen may well be in organic connexion with he molecule, not through the iron.

From 1906 onwards, Moureu devoted himself to he study of the rare gases present in French ineral waters, oil springs, etc., even extending his esearches in this field to Madagascar, where he ade a careful survey of the chemical resources of he island. For this last service he was promoted o the rank of Grand Officer of the Legion of Ionour. A summary of his work on the rare gases as presented to our Chemical Society, of which e was an honorary member, in a lecture which he elivered on June 14, 1923. Fifty-seven springs n all were studied. The results are very remark- ble. The amount of helium present varied greatly, eaching 5·92 per cent in the gas collected at Iaizieres, Côte d'Or. The other gases, krypton, rgon, neon and xenon, however, were present in ractically the same proportion, whatever the source. In 1913 he initiated an Institute of Hydrology and Climatology for the study of mineral waters and problems of climate in France and its colonies.

Being familiar with acrolein from his early studies, during the War Moureu sought to utilise this aldehyde as a tear excitant. The difficulty was to preserve it unchanged, as it soon set to a solid. Having traced the polymerisation to the action of acid formed by atmospheric oxidation, he set to work to discover means of preventing the change. He soon found that a great variety of substances could be used as anti-oxidants: phenols, aldehydes, amines, even potassium iodide. From 1919 onwards, Dufraisse and he, assisted by various young workers, systematically explored the field thus opened up, with the result that we are now in possession of a mass of exact data of extreme value. The full importance of the work, in its bearing upon vital phenomena, is yet to be realised. It is already clear that, more often than not, when two oxidisable substances are together subjected to attack by oxygen gas, oxidation is apparently inhibited because both are simultaneously oxidised to oxides which interact reversibly. Obviously, if the living organism were not in some way protected against excessive oxidation, through the heat developed, the action would necessarily tend to take place at an increasing rate: there is little doubt that, through what may be termed the Moureu effect, a control is exercised preventing excessive action. Maybe the office of some advitants is of this order.

Moureu's work in general is characterised by a breadth and philosophical exactitude which renders it of special importance and value. In him we lose a true chemist of the old school—a man who worshipped at the shrine of severe laboratory practice, a cult to-day by no means overpopular even in France. Fortunately, the name survives in his son, already a young chemist of distinction.

Henry E. Armstrong.

Mr. H. C. Robinson.

Mr. Herbert Christopher Robinson, who was born in Liverpool on Nov. 4, 1874, died on May 30 last, after an illness which had lasted for nearly a year. Mr. Robinson belonged to one of the leading Liverpool families, whilst one of his uncles, Mr. William Fothergill Robinson, had been Vice-Chancellor of the Duchy of Lancaster.

Robinson was educated at Marlborough College, and on leaving school went to the Royal School of Mines, for which he had obtained a scholarship. In 1894, constant ill-health compelled him to give up his studies, and he then commenced his career as a zoologist at Davos, where he resided for a couple of years. Here his health considerably improved, and in 1896 he went to Queensland, where he made a large collection of birds in Cooktown and its vicinity, but was obliged to return home owing to chronic dysentery. On his return to England he was appointed an assistant in the Liverpool Museum, where between 1897 and 1900 he

assisted Dr. H. O. Forbes to publish catalogues of the bird collections in that Museum. In 1901 he accompanied Dr. N. Annandale, who was then Director of the Indian Zoological Survey, to the Malay Peninsula, on an expedition attached to the Skeat Expedition which had been organised by the Royal Society of Edinburgh and by the University of Liverpool. The results of this expedition appeared in several volumes between 1903 and 1907, that on birds being written by Mr. Ogilvy Grant in 1905—but the work, which was entitled "Fasciculi Malayenses", was unfortunately never completed.

In 1903 Mr. Robinson was appointed curator of the Federated Malay States Museums, and shortly afterwards, on the resignation of the Director, Mr. Wray, he was promoted to that appointment, which he held until his resignation in 1926. From this time forward Mr. Robinson—latterly often in conjunction with Mr. Boden Kloss—wrote from time to time many articles on the various branches of zoology, though principally on the Vertebrata. In addition to this, Mr. Robinson organised and directed both the Federated Malay States Bureau of Fisheries and also the Meteorological Service. For the last two years of his service Mr. Robinson was in charge of a section of the Malayan Pavilion at the Wembley Exhibition. Throughout his directorship of the Federated Malay States Museums, Mr. Robinson wrote principally in the *Journal* of those Museums, the *Journal* of the Asiatic Society, and, to a less extent, in the *Ibis*.

Mr. Robinson was not only a scientific ornithologist with a wide knowledge of the literature of birds, but was also himself a keen and indefatigable field naturalist with an intimate knowledge of the birds in a state of Nature, a fact which made his writings of interest as well as of value. Among the more important of his articles may be mentioned the various catalogues of the birds of Siam, different States of the Malay Peninsula and the larger islands, which appeared from time to time in the journals already mentioned, as well as in the *Journal* of the Natural History Society of Siam. His most important work, however, was the one on which he was engaged at the time of his death, which he was producing for the Government of the Malay States. It was intended that this work on the birds of that country should be divided into five parts: (1) Commoner Birds; (2) Birds of the Higher Hill Stations; (3) Sporting and Shore Birds; (4) Birds of the Low Country; and (5) Remaining Birds. Of these parts only the first two have appeared, though we understand that part 3 was also practically finished before Mr. Robinson's death. The two volumes in print prove the great loss that ornithology has sustained in the death of Mr. Robinson.

It can scarcely be said of Mr. Robinson that he was widely popular, for he was very reserved; at the same time, the better he was known the more he was liked. In manner most unassuming, he was yet always ready to assist his brother ornithologists to the utmost of his capacity, and to these his death means the loss of a great personal friend and a clever scientific worker.

WE regret to announce the following deaths:

Dr. Etienne Bieler, deputy-director of the Imperial Geophysical Experimental Survey, at Geraldton, West Australia, on July 25, aged thirty-four years.

Dr. W. G. Duffield, Director of the Australian Commonwealth Solar Observatory at Mount Stromlo and formerly professor of physics at University College, Reading.

Dr. T. Blackwood Murray, formerly chairman and managing director of the Albion Motor Car Co., Ltd., and a past president of the Institution of Engineers and Shipbuilders in Scotland, on June 11, aged fifty-eight years.

The Very Rev. Dr. David Paul, a past president of the Botanical Society of Edinburgh and of the British Mycological Society, on July 12, aged eighty-three years.

Dr. R. B. Riggs, Scoville professor emeritus of chemistry at Trinity College, Conn., and a member of the college faculty for thirty-three years, on May 11, aged seventy-three years.

Prof. E. M. Terry, associate professor of physics in the University of Wisconsin, known for his work on the effect of temperature on the magnetic properties of iron, cobalt, and nickel, and also on radio telephony, on May 1, aged fifty years.

News and Views.

THE formation of a committee for the excavation of Caistor-by-Norwich, which has followed on the publication of an air photograph revealing the street plan of the Roman town, affords Dr. R. E. Mortimer Wheeler an opportunity for some pertinent comments in the June number of *Antiquity* on the question of the exploration of Roman Britain. In the last few years the excavation of Roman sites in Britain has been extended remarkably. It has attracted a great deal of public attention and the discovery of Romano-British antiquities has become 'news' in the public press. As a consequence, appeals for funds are made more widely known and meet with a more liberal response. Caistor is only one of a number of recent cases in point. At present it is true this applies in some degree to all archæological investigation; but in Romano-British archæology, as Dr. Wheeler points out, much of this effort is wasted and misdirected. He suggests that Romano-British research should be more systematically organised. It is expected that the complete excavation of Caistor will cost at least £15,000, and this exclusive of publication, without which research is of little value for the general advancement of knowledge.

INTERESTING as it may be expected that the results of the exploration of Caistor will prove, there are other sites, especially those in urban or developing areas, which may be regarded as more urgently in need of excavation—such sites, for example, as Caerleon, Colchester, and St. Albans, where changing conditions may in a short time preclude all digging

This argument is sound; nor should too much weight be allowed to the opportunism which Dr. Wheeler recognises as a factor in determining the exploration of any given site. At present the scene of the archæologist's activities must be fixed largely by its capacity to arouse practical interest in the form of funds to meet expenses. This depends in part only on its scientific importance and more often than not local support is a paramount necessity. But this element of opportunism might be eliminated to a large extent. In the past, Roman Britain has been a highly technical study, and even now its problems of a more general character are only vaguely appreciated by the public. If the questions which await solution and can only be answered by the spade were more frequently stated on broad lines in surveys of the position at a given moment—surveys, for example, such as that recently published by Dr. Wheeler himself in *Discovery*—public interest would inevitably take a practical form which would make systematic investigation a possibility free from the fortuitous attraction dependent upon locality.

IT is with much interest we learn that the Foucault pendulum for demonstrating the rotation of the earth is to be re-suspended in the Science Museum. For many years Foucault's notable experiment was to be seen in the old galleries now occupied by the Imperial War Museum, and it always created great interest. In its new position it will be seen by many who have never previously heard of it. Foucault, who was born in 1819 and died in 1868, described his pendulum to the Paris Academy of Sciences in February 1851, but he had already erected one in the Paris Observatory. It was some years afterwards to be seen on the Champ de Mars. According to the "Life" of Frank Buckland, the naturalist, the experiment was first shown in England at the old Polytechnic in 1851, the year of the Great Exhibition, and Buckland himself that year, with the aid of two sons of Chief Baron Pollock, suspended a Foucault pendulum from the roof of the nave of Westminster Abbey, of which his father, William Buckland, the distinguished geologist, was then Dean. Foucault's second method of demonstrating the rotation of the earth, by means of the gyroscope, was described in 1852. It is from that our modern gyroscopic compasses and other similar instruments come.

IT seems possible that in a year or two we shall not only be able to speak to people in all parts of the world by telephone, but also to see a clear image of them showing the tint of their complexions and the colour of their clothes. Colour television was first achieved by Baird in England. According to a recent *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., it has now been demonstrated more elaborately at the Bell Telephone Laboratories by Dr. Ives, whose father, Dr. F. Ives, of Philadelphia, invented one of the first and best methods of colour photography. In this method three photographs are made of the same scene. One is taken through a red glass filter and records all the objects coloured red, another records all the blues, and the third records all the greens. These are made into lantern slides, and in a triple lantern all three are projected on the same screen. Over the slide showing the reds is placed a red glass, over the one showing the blues a blue glass, and over the one showing the greens a green glass. The combined picture on the screen gives a natural colour reproduction. In ordinary television a group of photoelectric cells picks up varying light as the spots of the scanning disc show bright or dark areas on the object. The cell converts the moments of brightness into electric impulses which are transmitted by radio or by wire. In order to obtain colour television, we must use three groups of cells, one covered with a red filter, the second with a blue, and the third with a green. Red rays reflected from the object pass through a scanning disc and then through the red filter, and are stopped by the other filters. The electric impulse from the cells passes through vacuum tube amplifiers and over wires to the receivers, where it operates a glow lamp in front of which is a red screen, finally passing through another scanning disc. Similarly for the other colours, and we thus can get a combined image showing the natural colours. This development has been made possible by recent improvements in the manufacture of photoelectric cells.

THE two new short wave radio stations in New Jersey, U.S.A., for receiving and transmitting transoceanic telephonic communications have now been opened. Four channels from these stations are now in operation, two to Europe, one to South America, and one for experimental purposes. We learn from the *Bell Laboratories Record* for July that three frequencies are used, namely, 19,000, 14,000, and 9000 kilocycles respectively, corresponding to 16, 22, and 33 metres. Power for the transmitter is purchased from a supply company and is finally delivered into the line at 10,000 volts from a large rectifier. The antennæ consist of curtains of vertical and horizontal wires strung between towers 180 feet high and 250 feet apart. Each antenna is 500 feet wide and there are nine antennæ looped up end to end, giving a total length of 4500 feet. The receiving sets have two stages of radio frequency amplification, six stages of intermediate amplification, and one stage of audio amplification. The antennæ used at the receiving stations are also directive. The signals coming from the required direction are thus greatly strengthened, and those coming from other directions are weakened and thus cause little interference. In selecting sites for the receiving stations, great care was taken to avoid the proximity of motor-car and aeroplane routes, their unshielded ignition systems having been found to cause serious interference. As radio communication between aeroplanes and earth is now compulsory, their ignition systems will have to be shielded, and hence this cause of trouble is eliminated. Motor-car ignition systems are only shielded when a radio receiving set is carried on the car. Limits have therefore been assigned to the distance at which motor-cars can approach the stations. Horses are generally used for transport in their immediate vicinity.

IT is to be hoped that the development in Great Britain of the 'grid' system of high-tension mains by the Central Electricity Board will, amongst other things, materially help the farmer, but as R. E. Turnbull points out in an article in the *Nineteenth Century* for June last, the question is almost entirely an economic one, for unless the current can be supplied at a sufficiently low rate it will not pay the farmer to change over from the other sources of power which he has already installed. Further, electricity will naturally tend to be dearer in rural than in urban districts, as there are fewer consumers per square mile to share the costs of distribution. However, rural electrification has been carried out with great success in other countries such as Germany and Sweden, and it is stated on good authority that there is no fundamental reason why it should not be made a paying concern in England. In Canada also, the use of electricity is revolutionising both domestic and farm labour. It is particularly with regard to capital costs of transmission and distribution that England is at a disadvantage compared with other countries. Overhead lines, which on the Continent cost £150 to £200 per mile, cost as much as £600 to £800 per mile in England owing to Government restrictions. Competition with the gas industry and a local rather than a national method of dealing with the supply are other reasons why we are backward in our use of electricity. The lack of natural water power is not such a disadvantage as is often thought, for costly engineering works may be required before that natural power can be utilised.

A SCHEME has now been started in the Bedford area to test how far it is economically possible to extend the use of electricity in the rural districts of England. Active propaganda is to be carried out with the view of increasing the demand and awakening interest, demonstrations and hire or hire-purchase of electrical apparatus being included in the programme. Restrictions are being removed so that the cost of overhead lines will be less than £200 per mile, and it is thought that loss will be incurred for the first three years only. Similar developments will be made in other parts of the country if the Bedfordshire scheme proves successful. The wisdom of giving the farmer a subsidy on his crops has always been a debatable question, and it is suggested that a useful compromise would be found if a subsidy were granted to all authorities undertaking to supply electricity within their own rural area. The farmer would undoubtedly benefit, many other industries would obtain similar help, and new industries would tend to arise in the country districts, thus relieving the congestion in the towns. The farmer must in some way increase his output if he is to compete successfully with other countries. The use of electricity has been shown to achieve this, but in order to be an economic advantage the supply must be reasonably cheap.

THE jubilee of the Royal Zoological Society of New South Wales was celebrated on Mar. 24. Much water has flowed under the bridge since that date in 1879, when the New South Wales Zoological Society was formed "for the introduction and acclimatisation of song birds and game, and for other objects set forth in the prospectus". From the beginning the scheme had the support of the Government, and its donation of £500, together with private donations, allowed of the erection of aviaries and a keeper's house on 'Billygoat Swamp'. Gradually the gardens here expanded until, 11 acres in extent, they were found to be too cramped and unsuitable for their purpose. In 1911 the Government offered a choice of several new sites near Sydney, and Bradley's Head having been unanimously agreed upon, by 1913 £6000 had been expended and the new site had been cleared, fenced, and planted with some 2000 trees, shrubs, palms, and ferns. In 1916, when the enclosures were almost ready for the reception of the animals, the whole collection was transferred from the old Council to Trustees, and in 1917 the prefix 'Royal' was granted. The transference of the collections meant much more than a mere 'flitting', for since that time the Society has intensified its efforts to promote and advance the science of zoology. To this end it has worked with great success, as five volumes of the *Australian Zoologist*, as well as monographs on the fishes of New South Wales and the Australian Loricates, bear witness. The intensive study of the various branches of the science has been furthered by the establishment of specialised sections, and the monthly meetings of these are well attended and have stimulated research work both in the field and in the cabinet. We extend our congratulations to the Society on the good work it has accomplished and is carrying on for the behoof of popular and technical zoology.

A SURVEY of the utilisation of land in the county of Northampton has been published in three one-inch sheets by the Northamptonshire Education Committee. The survey was carried out by the pupils of the elementary schools of the county, under the guidance of their teachers and the general supervision of Mr. E. E. Field. The work was originally recorded on six-inch maps, and is now reduced to one-inch and printed by the Ordnance Survey. Three colours are used: light green for grassland, dark green for woods, and brown for cultivated land including rotation grasses and fallows. Building areas and mineral workings are uncoloured. The map is the first of its kind for a whole county, and is the sort of survey which is much needed in relation to various geographical and economic problems. Its construction must have been of great educational value to the children who took part, for it entailed an exploration of the region about the school and home and gave practical experience in the use of large-scale maps.

IN the June issue of *Sunlight* (Vol. 1, No. 8, p. 21), Dr. Vevers, the superintendent of the Zoological Society's Gardens at Regent's Park, London, describes the beneficial effect of fresh air and sunlight upon the animals. In the new monkey house, all the animals have access to the open air, the windows are of 'vitaglass', and in winter the cages are warmed by steam-heated panels and artificial sunlight is provided in the form of quartz gas-filled incandescent lamps.

By this means some of the most delicate monkeys and marmosets have been kept in perfect health through a severe winter. The effect upon the *moral* of the animals is also very noticeable. In the reptile house, similar good results have been obtained. The giraffes are among the latest zoo inmates to receive the benefit of artificial sunlight and radiant heat, and the success of the installation has been conspicuous.

THE disaster to the *Italia* airship off the north of Spitsbergen last year found Norway unequipped with any vessel of sufficient power and strength for navigation among heavy pack-ice. Appeal had to be made to the Soviet Government for the loan of an ice-breaker. The Norwegian government has now begun the construction of a vessel specially designed for ice navigation in view of Norway's interest in Spitsbergen. *La Geographie* for March–April gives some details. The vessel is to be some 230 feet long, with a beam measurement of 33 feet and a tonnage of 1275. It will be steam driven and both coal and oil burning. The engines will have 2000 h.p. and a speed of 15 knots is expected. The ship will have a cruising radius of about 7000 miles. There will be space for an aeroplane on deck. The ship is not to be primarily an ice-breaker, but it will be specially strengthened for ice navigation.

THE National Radium Trust has appointed Mr. P. Barter, of the Ministry of Health, Whitehall, to be secretary of the Trust, and Mr. Niven F. McNicoll, of the Department of Health for Scotland, to be assistant secretary.

MORE than six months before the opening of the next British Industries Fair, only five per cent of the total space in the new and enlarged Olympia, where the London section of the Fair is to be held on Feb. 17–28, remains unlet. In some trade sections of the London Fair there is no room left at all. The applications for space in the heavy section of the Fair, which is held simultaneously in Birmingham, are such that the question of further extensions is again becoming urgent. According to the scheme agreed upon by the advisory committee of the exhibitors in the London section of the Fair, the scientific section will be on the ground floor of the main hall, Olympia.

AT the tenth annual meeting of the American Geophysical Union on April 25 and 26, the following officers were elected—*Chairman:* Dr. Wm. Bowie; *Vice-Chairman:* Mr. L. H. Adams; *General Secretary:* Dr. J. A. Fleming. Sectional officers were elected as follows, the chairman, vice-chairman, and secretary being given in that order: *Section of Geodesy*—Mr. W. D. Lambert, Dr. L. J. Briggs, Mr. H. G. Avers. *Section of Seismology*—Mr. N. H. Heck, Dr. F. Wenner, Mr. F. Neumann. *Section of Meteorology*—Mr. G. W. Littlehales, Dr. W. R. Gregg, Mr. O. H. Gish. *Section of Terrestrial Magnetism and Electricity*—Mr. D. L. Hazard, Prof. L. W. Austin, Prof. H. W. Fisk. *Section of Oceanography*—Mr. A. H. Clark, Dr. H. B. Bigelow, Mr. H. A. Marmer. *Section of Volcanology*—Dr. A. L. Day, Mr. R. L. Daly, Dr. C. N. Fenner.

THE Secretary of State for the Colonies, with the approval of the Treasury, has appointed the following committee in accordance with section 1 of the Colonial Development Act, 1929: Sir Basil Blackett (chairman), Mr. Ernest Bevin, Sir John Eaglesome, Mr. R. H. Jackson, Sir Felix Pole, and Mr. Alan Rae Smith. According to the terms of reference the committee will "consider and report on, in the manner to be prescribed in the regulations to be made by the Secretary of State under section 1 (9) of the Act, applications for assistance from the Colonial Development Fund, in furtherance of schemes likely to aid and develop agriculture and industry in the Colonies, Protectorates, and Mandated Territories, and thereby promote commerce with, or industry in, the United Kingdom by any of the means specified in section 1 (1) of the Act". Mr. E. B. Boyd and Mr. C. G. Eastwood, of the Colonial Office, have been appointed respectively secretary and assistant secretary to the committee.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A teacher of electrical engineering in the Jarrow Secondary School—The Director of Education, Shire Hall, Durham (Aug. 16). A civil engineering draughtsman under the West Midlands Joint Electricity Authority—The Chief Engineer and Manager to the Authority, Central Administrative Offices, Phœnix Buildings, Dudley Road, Wolverhampton (Aug. 17). A keeper of the Art and Industrial Division of the National Museum, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Aug. 22). A lady guide-lecturer in the Leicester City Museum and Libraries—The Director, Museum and Libraries, The New Walk, Leicester (Aug. 24). A teacher of theory and design of structures at Goldsmiths' College, New Cross—The Warden, Goldsmiths' College, New Cross, S.E.14 (Aug. 26). An assistant in the Herbarium of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 26). A visiting teacher of chemistry and physics in its relation to photo-engraving at the L.C.C. School of Photo-engraving and Lithography—The Education Officer (T. 1a), County Hall, Westminster Bridge, S.E.1 (Aug. 27). An assistant curator at the Leeds City Museum—The Committee Department, Town Clerk's Office, 26 Great George Street, Leeds (Aug. 27). A chief inspector of weights and measures under the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Aug. 31). Junior assistants in the Metallurgy Department of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Aug. 31). A junior lecturer in electrical engineering at the East London College—The Registrar, East London College, Mile End Road, E.1 (Sept. 1). A demonstrator in the Department of Physiology of the Middlesex Hospital Medical School—The School Secretary, Middlesex Hospital Medical School, W.1 (Sept. 1). An assistant lecturer in agriculture under the Cornwall County Council Education Committee—The Secretary for Education, Education Department, County Hall, Truro (Sept. 6). An assistant lecturer and demonstrator in metallurgy at the University College of South Wales and Monmouth-

shire—The Registrar, University College, Cardiff (Sept. 14). A director of the Ceylon Coconut Research Scheme—The Assistant Agricultural Adviser to the Secretary of State for the Colonies, 2 Richmond Terrace, Whitehall, S.W.1 (Sept. 14). A librarian of the National Library of Wales—Dr. D. Davies, Plas Dinam, Llandinam, Montgomeryshire (Sept. 28). Professors of surgery, medicine, and bacteriology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (Oct. 19). A laboratory assistant at the King Edward VII. School, Sheffield—The Head Master, King Edward VII. School, Sheffield. A full-time lecturer in mechanical engineering at the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A technical office assistant in the Mechanical Department of the Egyptian State Railways, Telegraphs and Telephones Administration—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. A Grade "C" experimental officer at the Army Signals Experimental Establishment—The Superintendent, Signals Experimental Establishment, Woolwich, S.E.18.

Our Astronomical Column.

Brilliant Detonating Fireball on July 28.—This object made its appearance at 2 A.M. (summer time) on July 28 and was noticed by a number of observers who happened to be out of doors or looking from windows at the time. The object passed from over the sea north-north-west of Cornwall in a direction to south-south-east, and appears to have descended into the sea near Falmouth. Several observers describe the fireball as leaving a long, glittering train of sparks in its wake and as giving a loud detonation, which reached them soon after the light vanished. Some observers who did not see the actual flight of the object across the heavens thought the sudden illumination and thunder-like noise were due to an electrical storm; others thought an earthquake had occurred, for buildings in Falmouth were shaken and many people were awakened. The body of the fireball was of sensible size and seemed to one observer to have a diameter about twice as large as that of the sun. The whole countryside was lit up for two or three seconds and the full moon was paled into insignificance. The object must have penetrated to within a few miles of the earth's surface, for a few of the observers saw it apparently fall into the sea. Quite possibly it descended a little to the south-east of Falmouth, but further observations are required before the exact path can be ascertained.

The Observatories of Paris and Meudon.—*La Science Moderne* for July has an interesting article on the history of these observatories, with reproductions of old prints, one of which portrays Louis XIV. visiting the Paris Observatory shortly before its completion. It contained a museum, in which many early astronomical instruments were exhibited. It was Auzout who persuaded Louis that such an observatory was needed in France; the building was commenced in 1667 and completed in 1672, Perrault being the architect. Among the early observers we find the famous names of Cassini, Maraldi, Picard, Roemer, Huygens. Cassini here discovered the division in Saturn's ring, and four of its satellites, and Roemer made the first determination of the velocity of light. The reproduction of a woodcut made early in the eighteenth century helps us to realise the manner of observing with the enormously long refracting telescopes that were then in use; one was pivoted on the roof of the observatory, another on a high tower in the grounds. The article also describes the recent work at the two observatories, and gives a reproduction of one of Janssen's large-scale photographs of the solar 'rice-grains' on the scale of 1·20 metre to the sun's diameter.

The Nebula in Andromeda.—In the *Astrophysical Journal*, vol. 69, p. 103, Dr. E. Hubble continues his researches on nebulæ with a detailed study of the great spiral *M* 31, based on 350 photographs taken with the 60-inch and 100-inch reflectors at Mount Wilson. Owing to the size of the image, attention was concentrated on four regions giving a total area of about 40 per cent of the whole nebula. No indications were discovered of resolution into stars in the nuclear regions, though the outer and intermediate regions were partially resolved. Fifty variables were found, of which forty are definitely Cepheids with periods between 10 and 48 days. The latter show the period-luminosity relation conspicuously and give the distance of *M* 31 as 275,000 parsecs. The number of photographically observed novæ (previously 22) has been raised to a total of 87, and these form the basis of an interesting statistical discussion. A tentative comparison with the galactic system suggests that the latter is much larger than *M* 31, but that the ratio is not greater than that between *M* 31 and other extra-galactic systems.

Report of the Cape Observatory for 1928.—The report of His Majesty's Astronomer at the Cape has lately been issued. Upwards of 13,000 observations of right ascension and declination were made with the reversible transit circle. The stars under observation were: (1) zodiacal stars; (2) those south of declination −30° and not fainter than mag. 7·5; (3) Eros comparison stars for the near approach of that planet to the earth in 1930–1931. Heliometer measurements of the major planets were made near opposition, in continuation of the series commenced by Sir David Gill. A wide-angle lens, covering a field of 25 square degrees, with aperture 6 inches and focal length 80 inches, is under construction by Messrs. Taylor and Hobson of Leicester. This will be used for the construction of zone catalogues of stars from −30° to the south pole, on the plan inaugurated by Prof. Schlesinger. The Victoria telescope is being used for photographic determination of stellar parallaxes. 101 parallaxes are ready for publication, and material is available for determining about 100 more. Five parallaxes of more than a tenth of a second are noted, three of these being new. With the astrographic telescope, besides the ordinary programme, 14 plates were taken of Nova Pictoris, 9 of the bright comet 1927*k* Skjellerup, and 6 of Forbes's Comet. The repetition of the photography of the Cape astrographic zones has now been completed, and the determination of proper motions is in progress. It is stated that a series of photographs of Nova Pictoris, taken with the Victoria telescope using colour filters, show that the rings round the star are an optical phenomenon due to the peculiar distribution of light in the spectrum, and the colour-curve of the objective. The spectrum of the Nova in July 1928 was photographed with this telescope, using an objective prism in front of the object glass. It was a bright-line spectrum approximating to the Wolf-Rayet type. The continuous spectrum was weak; the line at λ4363 was strong.

Research Items.

Sinanthropus Pekinensis: Further Discoveries.—Further investigations by the Geological Survey of China at Chou Kou Tien during the season of 1928 have brought to light more *Sinanthropus* material from the site on which the type form molar tooth was previously discovered. The new material is described in general terms by Dr. Davidson Black in *Science* for June 28. It consists of the greater part of the right horizontal ramus of an adult lower jaw with the molar teeth *in situ* and having the premolar canine and distal half of the lateral incisor sockets preserved. Further, there are a worn right upper molar with evidence of injury during life, the labial side of the crown and portion of the root of a permanent median incisor, an immature lower median incisor and the root of a worn lower permanent median incisor posthumously crushed and deformed. All the specimens are deeply pigmented and mineralised. Though not found in the same deposit as the earlier material, there can be no doubt as to their contemporaneity and their geological age—Lower Quaternary (Polycene). The greater part of this material has still to be prepared and studied in the laboratory, but enough is now available to make it possible to draw certain conclusions. It is evident that *Sinanthropus*, like *Eoanthropus*, was a large brained form though the calvaria is not unduly thick. The morphology of the jaw of the two specimens presents features of unusual interest. The general architecture of the symphysis region makes it evident that the very generalised hominid dentition is supported with a framework of a type hitherto encountered only among forms having relatively formidable canines. The architecture of the jaw is much less hominid than that of the teeth; it supports and represents a type which, until the discovery of *Eoanthropus*, had been supposed to be associated only with an anthropoid type of dentition. It is clear, therefore, that distinctive hominid teeth were evolved before the supporting jaw lost its anthropoid form.

Is Evolution Continuous or Discontinuous?—Very considerable modifications have taken place in the views regarding the nature of Darwinian variations and mutations since these processes came into opposition as the alternative bases of the origin of species. Dr. Francis B. Sumner, in a short article in the July *Scientific Monthly*, summarises the present day point of view. He indicates that although the mutationists still 'stick to their guns', deductions from the results of genetic experiments, while allowing discreteness to the gene, have added to it a content of quantitative potentialities or values. So that mutation in the new view is no greater a 'saltation' than variation was in the old. It comes to this, apparently, that mutation is hereditary variation, regardless of magnitude, that is to say, it is a hereditary (transmissible) modification of the germinal substance, while the alternative variation is a non-hereditary change, due, as is commonly assumed, to the action of environment, broadly speaking, upon the individual. If mutation be regarded as of this minimal type, then evolution is due to a process which, while discontinuous in essence, produces a sensible continuity, for in the author's opinion the transition from one species to another has commonly involved no greater breaks in continuity than may now be observed between one individual and another in the same species.

Alcoholism.—The June issue of the *Bulletin of Hygiene* contains a review of recent literature on alcoholism, by Dr. J. D. Rolleston, whose previous contributions to this subject were noted by us last year (NATURE, Aug. 25, 1928, p. 285). The review deals with the historical aspects of alcoholism, its prevalence in Great Britain, France, Germany, Denmark, Russia, and the United States; its association with other morbid conditions, especially cancer, pellagra, and mental disease, experimental work, tests of drunkenness, mortality, legislation, and modes of prevention. A bibliography of 40 references to the literature of nine different countries is appended.

Changes in the Earthworm Fauna of Illinois.—Frank Smith records changes in the earthworm fauna of Illinois (*Bull.*, Div. Nat. Hist. Survey, State of Illinois, vol. 18, art. 10, 1928). The tendency is towards an increasing domination of European species and a corresponding decrease in the abundance of some indigenous forms. The author compares collections which he and others made thirty years ago with recent collections, and records that about 1896 only a few specimens of *Lumbricus terrestris* were seen in a restricted locality near Champaign crawling about during a rain storm. For several years afterwards specimens of this earthworm needed for class-work had to be obtained from dealers elsewhere, but about 1905 specimens were fairly abundant in the Arboretum in the University campus. Later the neighbouring area became abundantly stocked with them, while specimens of *Diplocardia communis*, which was formerly common, became infrequent. The area in Champaign into which *L. terrestris* has extended its distribution has also greatly increased in recent years.

Gas Vacuoles of *Arcella*.—The April issue of the *Quarterly Journal of Microscopical Science* (vol. 72, pt. iv.) is devoted to a memoir by the late Dr. Edward J. Bles on *Arcella*, and is a study in cell physiology. The experiments were devised by Dr. Bles and carried out with his well-known skill and care. He describes the morphology of *Arcella discoides*—the species selected for observation because of its transparent test, which is paler in colour, and flatter than that of *A. vulgaris*—and how he obtained a constant supply of young examples for study. The original object of the investigation was to determine the nature of the contents of the gas vacuoles in *Arcella*, and the author states that the gas is pure oxygen—if any other gas is present it is only in exceedingly minute traces. The oxygen is produced by oxidase action. The generally accepted view that the gas in the vacuoles is carbon dioxide is founded on a single experiment by Bütschli, and the author shows that this conclusion is untenable. The movements of pseudopodia from their protrusion to their disappearance are connected directly with the activity of an oxidase (the granules of which stain blue with benzidine), and on applying the benzidine test to several flagellates and ciliates it was found that a similar oxidase was present in them, and the author adduces evidence in support of his view that there is in these cases as in *Arcella* a similar method of converting the chemical energy of the oxidase action into the energy used in movement. The paper is illustrated by eleven plates of excellent drawings by Mr. A. K. Maxwell.

Evolutionary Sequence among Protophyta.—At the present time, eleven classes of simple, holophytic organisms are recognised, in no two of which do chromatophore pigments, reserve substances, and cell membranes show complete correspondence. In Fritsch's review of these classes under the title of "Evolutionary Sequence and Affinities among Protophyta" (*Biol. Reviews*, vol. 4, April 1924), it is brought

out very clearly that these classes may be regarded as parallel evolutionary series, most of which are represented by forms ranging from motile flagellate organisms to typical algæ types such as the chlorococcoid, filamentous, siphonaceous, etc. In fact, it is in only two of the eleven classes, the Euglenineæ and Chloromonadales, that typical algal forms are still unknown. In view of these facts, it is only reasonable to agree with Fritsch that the purely artificial distinction into Flagellata and Algæ should be abandoned. Recent work has also brought about a readjustment of the groups formerly included under the Chlorophyceæ. Borzi's original suggestion that yellow-green, oil-forming organisms should be placed in a class distinct from that containing the green, starch-forming organisms, has received ample justification and such forms are now classified as Heterokontæ —a group of equal rank with Chrysophyceæ, Bacillariales, etc. On the other hand, Bohlin's group Stephanokontæ, and Blackman and Tansley's Akontæ, do not receive equal support, and the tendency at the present time is to reduce these to the rank of subgroups co-equal with Ulotrichales, Siphonales, etc., of the large class Isokontæ, with the other sub-groups of which their metabolism is in agreement. The classification of the Isokontæ now appears to be satisfactorily established, but much work still remains to bring the other groups into an equally satisfactory condition.

Theories of Coral Reefs.—Wharton's view that foundations for coral reefs have been furnished by the marine abrasion of volcanic islands is shown by Prof. W. M. Davis to be untenable as a general explanation (*Science Progress*, July 1929). Darwin's theory involves slowly subsiding volcanic islands, and therefore uncliffed and bayed shore-lines would be expected, and such evidence as is available of the original foundations should reveal the slopes of a dissected cone. In contrast, Wharton's theory demands cliffed and non-embayed shore-lines, and uplifted reefs ought to be based upon flat platforms. It is shown that both Darwin and Wharton overlooked these and other inevitable consequences, but that, whereas Wharton's theory is found to be contradicted when it is confronted by the facts of exploration, that of Darwin is convincingly confirmed. The article is stimulated by a review of "The Coral Reef Problem", in which Prof. J. Stanley Gardiner suggests that Wharton's theory has not been proved untenable by definite evidence. Prof. Davis has now specifically answered this criticism in a paper which is not only a valuable summary of coral-reef evidence but also an admirable lesson in scientific method.

Continental Drift.—The attention of geologists is directed to a review of the continental drift hypothesis by Prof. Arthur Holmes (*Mining Magazine*, April, May, and June 1929). Evidence is summarised suggesting that the movements involved in the changes that have affected the face of the earth since the close of the Palæozoic include (*a*) a breaking up of Laurasia and Gondwanaland with a radially outward drift of the individual parts of each area towards the Pacific and the Tethys; and (*b*) a general drift, probably involving the whole of the crust, with a northerly component on the African side sufficient to remove Natal from the neighbourhood of the late-Carboniferous south pole and Britain from the late-Carboniferous tropics. It is shown that the motive force cannot be of external origin but must arise within the earth itself. What is required for (*a*) is a mechanism operating beneath the continents capable of stretching or splitting them and of dragging the parts away from each other. The radially outward movements suggest a system of convection currents generated by differential radioactive heating beneath each of the two great land-masses. The importance of recognising thermal and electromagnetic processes as well as those due to gravitation is emphasised.

Effect of Nuclear Spin on Spectra.—The line spectra of bismuth and cæsium have a hyperfine structure, the description of which falls outside the usual quantum theory of electronic motions. Stated formally, it requires the introduction of a new quantum number, and the corresponding physical accompaniment of this in the atomic model has been traced to the quantised rotation of the positive nucleus. The development of this idea on the quantum mechanics has been carried out by J. Hargreaves in a paper appearing in the July issue of the *Proceedings of the Royal Society*, for the relatively simple case of a nucleus with a half-quantum spin in an atom with a central field. After some empirical adjustment, the results of theory and experiment can be made to agree, and there emerges, *inter alia*, a rule for the most probable type of transition, namely, one in which there is reversal neither of the spin axis of the nucleus, nor of that of the electron which is responsible—loosely speaking—for the emission of radiation. Mr. Hargreaves suggests that some of the effects observed indicate that the charge of the nucleus is localised chiefly in its outer parts.

Raman Effect for X-Rays.—When homogeneous X-rays are scattered, some of the deviated quanta form a group which has hitherto been supposed to be of the same frequency as the incident beam. A careful analysis of this so-called unmodified radiation by D. P. Mitchell with a spectrometer of very high resolving power (*Physical Review*, vol. 33, p. 871) has now shown, however, that it is actually not homogeneous, but possesses a fine structure. The detail of the latter depends upon the nature of the scattering material, but is independent of the angle of scattering, and it is found that the changes in frequency correspond fairly well with characteristic frequencies of the atoms responsible for the scattering. The effect thus appears to be analogous to that discovered in the region of optical frequencies by Raman and Krishnan, except that the transitions involved are electronic in the case of X-rays, and molecular for the Raman spectra. It is perhaps somewhat difficult to picture how, as has been observed in one instance, the frequency of an X-ray can be increased by electronic scattering, and it also seems necessary to assume that when an X-ray has its frequency diminished, the electron concerned is only taken to the periphery of the atom, and then left there at rest.

A Simple Audio-Frequency Oscillator.—Most laboratory courses in physics and chemistry include electrical bridge measurements for which an alternating current supply is needed, and it is a common experience of instructors that these often prove extremely troublesome to operate. Mr. C. W. Oatley has described a low-power audio-frequency oscillator in the July number of the *Journal of Scientific Instruments*, which appears to be a considerable advance on previous pieces of apparatus used for this purpose. It consists essentially of a valve-maintained tuning-fork, of the type introduced by Dr. Eccles. The alternating voltage from this is taken to benches round the laboratory, and is amplified by a single-valve circuit on each, the bridge terminals being finally connected to tapped transformers on the anode circuits of the latter. A special feature

of the circuits described is that the only source of power required, both on the high-tension side and the low-tension side of all the valves, is the 110 volt D.C. main. In the actual circuit for which the details are given in this paper, the fork has a frequency of 180 cycles per second, and yields immediately 10 volts r.m.s. The maximum voltage which can be used on the bridge is 30 volts r.m.s., but Mr. Oatley's arrangements would appear to be susceptible of considerable modification, and apparatus similar in principle could be readily set up in most laboratories.

Crystallisation.—We have received from Dr. F. H. Maberley a note on a simple experiment in which half a stick of 'meta-fuel' is set on edge on a penny resting on a cork, is ignited and three-quarters allowed to burn. It is then blown out, and the sublimate collecting is examined with a lens. It consists of delicate crystalline needles, some with branching ends.

Oxidation-Reduction.—The twelfth (1927), thirteenth, and fourteenth (1928) of the series on this subject being issued by the U.S. Public Health Service, which were referred to in NATURE of Aug. 3, p. 213, have recently come to hand. A reply is made to Kodama's criticisms of the author's work on the Schardinger reaction, the previous results being confirmed. The thirteenth paper describes the preparation of 34 indophenols, many of which are new; all can be used as oxidation-reduction indicators, but nine are listed as being specially useful. The fourteenth presents data on the equilibrium potentials of four of the new indophenols, which are all rather easily prepared and have useful properties as indicators of oxidation-reduction. The potentials of three of the compounds lie at the electropositive end of the series, two of them extending the range beyond the limit previously reached with satisfactory reversible indicators. A revised list of useful oxidation-reduction indicators is also presented with their equilibrium potentials between pH 5·0 and 9·0 at intervals of 0·2 pH.

Solubilities of Calcium and Magnesium Carbonates in Water containing Carbon Dioxide.—The solubilities of calcium and magnesium carbonates in water containing dissolved carbon dioxide under varying pressures have been measured by Frear and Johnston and by Kline, respectively, and their results are stated in the July number of the *Journal of the American Chemical Society*. These authors give a critical summary of the work on the solubilities of the two substances in pure water at various temperatures and then describe experiments with water containing carbon dioxide. It is found that the concentration of calcium carbonate in solution is very nearly proportional to the cube root of the partial pressure of the carbon dioxide. The effect of the simultaneous presence of calcium sulphate was also investigated. In the case of magnesium carbonate, this was found to be stable down to a partial pressure of carbon dioxide of 0·004 atm., below which the hydroxide was stable. No indication of definite basic carbonates was obtained. The results are of importance in connexion with the use of hard waters in steam boilers and also in the theory of the formation of mineral deposits.

Heating Systems.—*Bulletin* No. 189 of the University of Illinois is the sixth dealing with an investigation of warm air furnaces and heating systems which is being conducted by the Engineering Experimental Station of the University in co-operation with the National Warm-Air Heating Association. A 3-story house has been built and equipped for testing at a cost of £5000, and the present bulletin deals with work carried out in this house by Profs. Willard, Kratz, and Day. It covers tests of efficiency, capacity, rating, and heat losses of commercial furnaces, heat insulators, sizes, positions, and resistances of air ducts, and the effects of conditions outside the house on their action. Six varieties of solid fuel have been compared, two types of chimney stacks and stove pipes, and the effect of providing thermal insulation in the ceiling has been determined. The loss of heat from the outside surfaces of the walls and windows and the influence of sunshine on it are to form the subject of a future bulletin.

Martinsel Steel.—Any improvement in the quality of steel for ships enabling scantlings to be reduced is welcomed by shipowners and shipbuilders. Among the new steels available is martinsel steel, which is referred to in a short article in the *Engineer* for July 19, by Mr. P. G. Rouse. The development of this steel was described in a paper read on Mar. 22 to the West of Scotland Iron and Steel Institute by Mr. F. G. Martin, who some seven years ago advocated the heat treatment of ship steel and the careful measurement of its elastic limit. It has been found that the elastic limit of steel depends on the arrangement of its microstructure, and this in ordinary ship steels is affected by the rolling. Martinsel steel is a special quality steel subjected after rolling to a special heat treatment ensuring the formation of a microstructure most favourable to the greatest elastic strength of the steel, and Mr. Rouse gives microphotographs of ordinary mild steel and the martinsel steel. Martinsel steel has been adopted by Messrs. Alfred Holt and Co. for their ships, and it is being used for the topsides and deck structure of the liner *Empress of Britain* now being constructed for the Canadian Pacific Steamships, Ltd. It allows a reduction of up to 12½ per cent in the thickness of certain parts. High elastic limit steel is also being considered for large bridges in which the saving of dead weight has a cumulative effect.

The Coefficients of Relativity.—In a short paper read before the meeting on June 21–22 of the Physical Society of America, Prof. S. R. Cook, of the College of the Pacific, Stockton, California, proposes to replace the well-known equations of the special theory of relativity, namely,

$$\left.\begin{aligned} x'=\beta(x-vt),\ y'=y,\ z'=z,\\ t'=\beta\left(t-\frac{vx}{c^2}\right);\end{aligned}\right\}$$

by the following set

$$\left.\begin{aligned} x'=\beta^2(x-vt),\ y'=\beta y,\ z'=\beta z,\\ t'_x=\beta^2\left(t-\frac{vx}{c^2}\right),\ t'_y=\beta t,\ t'_z=\beta t;\end{aligned}\right\}$$

where in both sets β denotes $(1-v^2/c^2)^{-\frac{1}{2}}$. The second set of equations introduces a transverse time as well as a longitudinal time, and is said to imply that clocks moving transversely to the direction of motion run more slowly than when at rest, but not so slowly as when moving in the direction of motion. The chief object of the communication, it is stated, is to inquire into the specific reasons for the universal adoption of the Einstein-Lorentz equations rather than those suggested by Prof. Cook. But in view of the facts that the Einstein-Lorentz equations are simpler, that they involve the two systems corresponding to the dashed and undashed letters in a perfectly reciprocal manner, and that their consequences have been very fully investigated, one cannot help feeling that before they can be given up a great deal more evidence must be furnished than is available in Prof. Cook's paper, which is described as a preliminary note.

Geology in Great Britain.

THE *Summary of Progress* for the year 1927 of the Geological Survey of Great Britain appears in two parts. Part I.[1] contains the Annual Report of the Geological Survey Board and of the Director. Eighty maps were published during the year, together with a number of memoirs, most of which have been already noticed in our columns (NATURE, Feb. 11, 1928). Among the new developments are the inception of a programme of geophysical work with the Eötvös balance; the authorisation of the sale of photographic copies of six-inch manuscript maps; and the opening out of a new district, the Orkney Islands. The volume also includes the field reports of the district geologists; an account of the petrology of the Cheviot rocks by Dr. H. H. Thomas; and details of nineteen new chemical analyses of rocks.

Part II.[2] contains thirteen original papers on British geology, thus extending in a welcome form last year's important innovation. Dr. W. E. P. M'Lintock and J. Phemister give an account of their gravitational survey along the line of the Swynnerton Dyke in Staffordshire; their investigation shows that in the proper hands this method is capable of affording valuable evidence regarding the situation and form of deep-seated rock-bodies. There is an interesting discussion relating to the origin of Cumberland iron-ores. E. E. L. Dixon attributes the hæmatite to a magmatic source, a hypothesis that is opposed by Bernard Smith. A new discovery of Lower Carboniferous basalts in the Lockermouth area, Cumberland, is described by T. Eastwood. The remarkable structures known as 'Ptygmatic Folding' have been found in great variety by H. H. Read in Sutherland, and he gives a valuable survey of various hypotheses that have been advanced to 'explain' them. There are also papers on the Yorkshire and Kent coalfields; on the geology of Manchester as exhibited in a tunnel; on new fossils from the Coal Measures; and on deep borings in the south-east of England and in Yorkshire. Altogether, this is a most valuable and stimulating publication which should be in the hands of every British geologist, whether he be an amateur, an honours student, or a teacher. The Survey is to be congratulated on having introduced such a medium for personal contributions and on having issued it at an attractive price.

To petrologists the most noteworthy publication of last year was Dr. Tyrrell's memoir on Arran,[3] a classic area which in Tertiary times was one of the great centres of igneous activity in the west of Scotland. This is the first complete account of the geology of the island. Though based on the descriptions of the northern two-thirds, which were included in Sheet 21 of the one-inch map of Scotland (1903), the treatment is unified and embodies the results achieved by many competent workers, including Mr. E. B. Bailey and Dr. Tyrrell himself, since that date. The earlier chapters deal with the crystalline schists of the north; with the black shales and spilites of Glen Sannox, which are reasonably assigned to the Lower Ordovician; and with the Carboniferous and New and Old Red Sandstone formations. The succeeding and greater part of the memoir is devoted to a detailed account of the Great Central Ring Complex and of the varied major and minor intrusions. Here there is much that is new, structural, petrological, and chemical, all replete with interest and scientific importance. Statistics of 525 dykes are presented, showing that the total extension of the crust in the east-north-east—west-south-west direction amounts to 5410 feet in 14·8 miles. In Mull the corresponding figures are 2504 feet in 12·5 miles.

The district described in the Northumberland memoir[4] includes Holy Island, the Farne Islands, and the delightful stretch of coast north and south of Bamburgh Castle, and extends inland to the edge of the Cheviots. The stratigraphy of the Lower Carboniferous and the tectonics are dealt with in greater detail than was formerly practicable, but it has been found that much of the earlier work by Gunn has required little or no revision. Important additions have been made to the chapter dealing with the Whin Sill and associated dykes, and the glacial deposits also receive more extensive treatment. There is a useful glossary of the local and mining terms of North Northumberland.

Part II. of the Wrexham memoir[5] continues the description of an area that includes the densely populated belt of the Denbighshire coalfield. The older formations were dealt with in Part I.; here the Coal Measures are described in detail with fossil lists, particulars of important shaft and boring sections, and a valuable account of tectonics. After a short chapter on the Triassic deposits, there follows a fascinating account of the mantle of glacial drifts left over half the area by the Irish Sea and Welsh ice-sheets. Mineral deposits and water supply are also adequately described.

The area covered by Sheet 153[6] is situated on the border between Staffordshire and Shropshire, and within it lie Wolverhampton and Lilleshall and an interesting stretch of the Severn Valley below Ironbridge and Broseley. The memoir is notable as being the first survey publication to describe the geology of the Coalbrookdale Coalfield. The solid-rock sequence described ranges from the Uriconian to the Triassic. Here again considerable attention is devoted to tectonics. The glacial and later deposits are significant of marked geographical changes, culminating in the development of the Severn gorge at Ironbridge.

The next memoir[7] to be noticed includes the towns of Ramsgate, Margate, Sandwich, Deal, and Dover, and covers a district that is well known for its coastal scenery and its excellent exposures of the Chalk. The work of the late Dr. A. W. Rowe on the succession of characteristic fossils has made this coast one of the younger classics of British geology. There is a short account of the concealed geology, but the memoir—and the new colour-printed maps—will be chiefly appreciated as an indispensable guide to the geology of a popular coastal district.

Prof. Boswell's memoir[8] describes the geology of a region that has long been an attractive field for geologists and students of the prehistoric periods of mankind. The neighbourhood of Woodbridge and Felixstowe is well known for its fine exposures of Crag de-

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1927. Part I. Pp. viii+82. 1*s*. 6*d*.

[2] Summary of Progress of the Geological Survey and Museum of Practical Geology for 1927. Part II. Pp. viii+110+4 plates. 2*s*. 6*d*.

[3] The Geology of Arran (Memoirs of the Geological Survey, Scotland). By G. W. Tyrrell. Pp. viii+292+6 plates. 6*s*. 6*d*. net.

[4] Explanation of New Series Sheet 4: The Geology of Belford, Holy Island, and the Farne Islands. By W. Gunn. Second Edition by R. G. Carruthers, C. H. Dinham, G. A. Burnett, and J. Maden. Pp. vi+195+3 plates. 4*s*. net.

[5] Explanation of Sheet 121: The Geology of the Country around Wrexham. Part 2: Coal Measures and Newer Formations. By C. B. Wedd, B. Smith, and L. J. Wills; with a Contribution by G. W. Lamplugh. Pp. xvii+237+5 plates. 5*s*. net.

[6] Explanation of Sheet 153: The Country between Wolverhampton and Oakengates. By T. H. Whitehead, T. Robertson, R. W. Pocock, and E. E. L. Dixon; with Contributions by T. C. Cantrell, H. Dewey, R. L. Sherlock, J. Pringle, and R. Crookall. Pp. xvi+344+8 plates. 5*s*. 6*d*. net.

[7] Explanation of Sheets 274 and 290: The Geology of the Country near Ramsgate and Dover. By H. J. Osborne White. Pp. vi+98+5 plates. 2*s*. 9*d*. net.

[8] Explanation of Sheets 208 and 225: The Geology of the Country around Woodbridge, Felixstowe, and Orford. By P. G. H. Boswell. Pp. v+80+2 plates. 2*s*. 6*d*. net.

posits, and the labours of Mr. J. Reid Moir have disclosed numerous examples of what may be primitive implements. The area, which extends from Aldeburgh to Harwich Harbour, is now represented by two of the new series of colour-printed maps.

The next three memoirs belong to a county series in which the sources of underground waters are described in considerable detail. The Warwickshire volume [9] gives a general account of the geology of the county, and of the water-bearing strata and springs. Leamington Spa and the water supplies of Birmingham and Coventry receive special attention. An excellent coloured geological map accompanies the Somerset memoir,[10] which gives particulars, like the others, of all the principal deep wells and borings, with the geological classification of the strata passed through. There is a full bibliography of the mineral waters of Bath. There have been two previous volumes issued on the water supply of Sussex, but the new memoir [11] now published brings the account of the water resources and borings up-to-date by the addition of much new information. All three memoirs contain analyses of the waters, and will prove invaluable to engineers and others in search of underground supplies.

There remains to be mentioned a useful list of geological photographs,[12] arranged under subjects, which has been compiled from the complete set of more than 7000 subjects accumulated by the Survey during the last thirty years. The list has been prepared to help teachers and the public in general towards a proper and rapid selection of the more instructive and striking photographs. Copies, either as prints, enlargements, or lantern slides, can be purchased on application to the Director of the Survey.

[9] Wells and Springs of Warwickshire. By L. Richardson. Pp. vi+204. 5*s*. net.

[10] Wells and Springs of Somerset. By L. Richardson; with a Bibliography of the Bath Thermal Waters, by W. Whitaker. Pp. v+279+1 plate. 7*s*. 6*d*. net.

[11] Wells and Springs of Sussex. By F. H. Edmunds. Pp. v+263+1 plate. 5*s*. net.

[12] Classified Geological Photographs from the Collection of the Geological Survey of Great Britain. Pp. iii+76. 1*s*. net. (London: H.M. Stationery Office, 1927–1928.)

The Forests of the Andaman Islands.

THE forests of the Andaman Islands were first reported on in 1866 by Mr. S. Kurz, Curator of the Herbarium of the Royal Botanic Gardens, Calcutta. At the instance of the Government of India, Mr. Kurz was deputed to explore these forests by Dr. Anderson, at the time superintendent of the gardens. Whilst recommending, in his interesting report, a certain amount of forest clearing for the extension of agriculture, and in order to render the settlement healthier, Kurz stated that, in his opinion, it was of the highest importance that the forests should be preserved, as they should have a considerable future value. Since the publication of this report the management of the forests of the islands has had a somewhat chequered career, but throughout a recognition of their value has persisted. The report on a recent "Tour of Inspection of the Forests of the Andamans" by Mr. A. Rodger, Inspector-General of Forests to the Government of India, should prove interesting reading to all having a knowledge of these interesting islands and their arborescent flora, so far as it is known (Calcutta: Govenment of India Central Publication Branch, 1928). The difficulties of working dense tropical forests by means of convict labour, and peopled in parts by an indigenous race of hostile people, need scarcely be emphasised; whilst the marketing of the products, even of so fine a timber as the padauk (*Pterocarpus dalbergioides*) has been fraught with unforeseen troubles. Mr. Rodger's report, however, goes to show that a turning point has been reached; and given the hearty and maintained support of the Government of India, which nowadays includes the Legislative Assembly and the Standing Finance Committee, these forests should become the source of an important export trade.

For many years, when the Andaman forests were alluded to, the average person thought only in terms of padauk, the sole timber then exploited. Other species, for trade purposes, were negligible. No less than fourteen different timbers are mentioned in the report, of which *Sterculia campanulata* is exported to Calcutta and Rangoon for match-making; Gurjan (*Dipterocarpus turbinatus*, *Griffithii*, *incanus* and *costatus*) to England, Madras, and Calcutta; the white chugalam (*Terminalia bialata*), which is in much demand as the source of silver grey wood; whilst the use of padauk is almost world-wide. A systematic survey of the forest crops for stock mapping purposes is now in progress, whilst a logging engineer has reported on the possibilities of introducing mechanical extraction to supplement the elephants and buffaloes at present employed. The engineer estimated that there are some 1870 square miles of forests which carry enough tonnage of timber per acre to make mechanical extraction possible. Even at the low figure of 20 tons per acre, this would give more than 20 million tons; and with a hundred year rotation an annual extraction of about 240,000 tons would be possible, or about nine times the present output.

The Inspector-General of Forests states that a rotation of a hundred years would be too short to produce the requisite sizes of the valuable species such as padauk, gurjan, and white chugalam; but, he adds, it must be remembered that the forests are full of over-mature timber which is certainly deteriorating, and should consequently be extracted as soon as possible. There would seem to be, therefore, every inducement for the Government to sanction the sums necessary for the introduction of the new methods of extraction recommended; the more so since the persistent efforts of the Forest Department have succeeded in placing on the market other species besides padauk, and that an increasing demand appears fairly certain.

On this head Mr. Rodger writes: "I have little doubt that the markets for Andamans hardwoods in India and England, and possibly also in South Africa, Mesopotamia, and elsewhere, can be gradually developed until we have an assured and profitable trade. . . . I look forward to the time when the very extensive mangrove forests of the Islands will be of value. Containing as they do as much as 160 tons of timber per acre, being most accessible and easily worked, it seems reasonable to imagine a time, not very distant, when the fuel market of Calcutta, now hard put to it to find enough fuel in the Sundarbans, will obtain its supplies from the Andamans. I understand that modern plant has been erected in the Philippines for the manufacture of tannin, wood alcohol, and charcoal from mangroves, and I see no reason why this should not be done in the Andamans."

The explorations now being carried out in these forests should produce fascinating results both botanical and zoological; some of the sylvicultural work already undertaken, in plantations and so forth, offers possibilities of considerable success. Mr. Rodger is to be congratulated on his most interesting report: for restrained, as is the case with official reports, though its phraseology may be, it proves that opportunities for carrying out work and investigations of considerable value and interest lie to the hand of the Andamans Forest Officer.

University and Educational Intelligence.

GLASGOW.—Sir Donald MacAlister, who has been Principal and Vice-Chancellor of the University since 1907, is retiring from the principalship in October next.

THE American Association of Museums is carrying out a scheme, for which it has this year obtained a grant of 118,000 dollars, for the construction of museums in Yellowstone National Park. Since 1924, when it obtained a grant of 70,500 dollars from the Laura Spelman Rockefeller Memorial for the establishment of a museum in the Yosemite Valley, this association has been very active in prompting the exploitation of the educational and scientific opportunities offered by the American national parks. In co-operation with the Carnegie Institution of Washington and the National Academy of Sciences, it established an observation station and museum at Yavapai Point in the Grand Canyon National Park, of which Dr. John C. Merriam, president of the Carnegie Institution, declared that it presented "one of the greatest educational and scientific possibilities of America or of the world". Some of the universities, notably Princeton and Northwestern, regularly hold courses in these reservations, and the Federal National Park Service and California Fish and Game Commission have for some years jointly conducted a field school of natural history in the Yosemite district which supplements the lower division of the university courses in botany and zoology and, incidentally, utilises the services of students as public guides. Last year the Secretary of the Interior appointed a committee of eminent men to make a survey of the educational possibilities of the parks. An account of these developments is given in the February number of *School Life*.

THE Commonwealth Government has appointed a Committee to consider the question of establishing a National University at Canberra. While not desirous at the present time of establishing an undergraduate university, the Government is of the opinion that a post-graduate University for the encouragement of original research work would be of very great service to the country and might well be initiated in the immediate future. The Committee is desired to examine the whole position and to report to the Council for Scientific and Industrial Research concerning: (*a*) The constitution and government of the said university; (*b*) its relations to the Council for Scientific and Industrial Research and to such other appropriate Commonwealth institutions as have been or may be established at Canberra; (*c*) its relations to the existing universities in the States, having regard to the consideration that it should be designed to supplement their work and not to compete in the training of undergraduates; (*d*) the departments of learning suitable for cultivation in the proposed university and the order in which they should be undertaken, whether at the outset or in the future; (*e*) the provision of a research teaching staff and of all necessary means of teaching and research, including buildings, laboratories, libraries, etc.; (*f*) the power to grant research degrees and the conditions under which such degrees should be granted; (*g*) the problem of endowments and financial administration; (*h*) any further matters which may seem to the Committee to require consideration in connexion with the proposed undertaking. Sir David Orme Masson is chairman of the Committee and the members are Sir Thomas Lyle, Sir Henry Braddon, Sir Robert Garran, Mr. A. J. Gibson, and, *ex officio*, the Executive Committee of the Council for Scientific and Industrial Research (Sir George Julius, Dr. A. C. D. Rivett, and Prof. A. E. V. Richardson).

Calendar of Patent Records.

August 11, 1598.—Edward Darcy's playing card patent, dated Aug. 11, 1598, which was an extension for twenty-one years of an earlier grant made to Ralph Bowes in 1588, for the sole making, importation, and selling of playing cards, was the cause of the famous law-suit known as "The Case of Monopolies", in which the common-law distinction between a patent for an invention and a monopoly in restraint of trade was clearly laid down. "Where any man by his own charge and industry or by his own wit or invention doth bring any new trade into the realm, or any engine tending to the furtherance of a trade that never was used before and that for the good of the realm, that in such case the king may grant to him a monopoly patent for some reasonable time, until the subjects may learn the same, in consideration of the good that he doth bring by his invention to the commonwealth, otherwise not." The grant, the avowed motive of which was to prevent able-bodied persons who might go to the plough employing themselves in the art of making cards, was declared contrary to the law, and the patent void.

August 11, 1868.—One of the earliest practicable typewriters was the invention of John Pratt and was patented in the United States on Aug. 11, 1868. The machine, which had a vertically disposed type-plate, movable in two directions to bring the required character to the printing point by means of connexions from the key levers, never came into practical use, but it was exhibited and worked at a meeting of the Society of Arts in 1866, the year in which the British patent was sealed; and it is said that an account of this meeting, which appeared in the *Scientific American* the following year, was the direct incentive that led Latham Sholes to the invention of the first Remington machine.

August 12, 1794.—The first patent for a ball-bearing was the English one granted on Aug. 12, 1794, to Philip Vaughan, ironfounder of Carmarthen, for the bearings of wagon axles. The axle box, having a ball race corresponding to a groove in the axle, was provided with a detachable section, secured in position by a wedge, to allow the balls to be inserted and removed.

August 12, 1851.—The sewing machine patent of Isaac M. Singer was granted in the United States on Aug. 12, 1851. Though this was not the first commercially successful sewing machine—the credit for the invention of which must be given to Elias Howe, whose American patent is dated five years earlier—it was on Singer's patent that the world-wide industry of to-day was founded (cf. Calendar of Patent Records, April 26 and July 17).

August 12, 1861.—The Langen 'bell and hopper' for the charging of blast furnaces, in which a central member in the form of a plug seats downwards in the bottom of the hopper to close it instead of being pulled up from beneath as in the usual type, was patented in Prussia by Eugene Langen on Aug. 12, 1861. The invention produced excellent results, but has not had very extensive application outside Germany.

August 14, 1839.—The first photography patent was the English one sealed in the name of Miles Berry, the patent agent, on Aug. 14, 1839, for "A new method of obtaining the spontaneous reproduction of all the images received in the focus of the camera obscura", as communicated to him by J. M. Daguerre. Daguerre was refused a French patent in order that the invention might at once be given to the public, but he was granted a government annuity of 6000 francs for "la gloire de doter le monde savant et artiste d'une des plus merveilleuses découvertes dont s'honore notre pays".

Societies and Academies.

Dublin.

Royal Irish Academy, June 24.—**Brian Coffey** and **Hugh Ryan**: The action of alcoholic hydrochloric acid on certain unsaturated ketones. Alcoholic hydrochloric acid with α-benzylidene-methylethyl-ketone gave a crystalline substance, m.p. 195°-196° C. with formula $C_{22}H_{24}O_2$, from which a tribromide $C_{22}H_{21}O_2Br_3$, m.p. 171°-172° C. was obtained. Unlike α-benzylidene-methylethyl-ketone, it did not condense with either piperonal or methylethyl-ketone and was stable towards mild reducing or oxidising agents. It proved to be the dimer

$$\begin{array}{l} C_6H_5.CH.CH.CO.CH_2.CH_3 \\ \qquad\quad | \quad | \\ C_6H_5.CH.CH.CO.CH_2.CH_3. \end{array}$$

The same substance was formed by the action of stannic chloride on an alcoholic solution of the mono-ketone. In a similar manner α-anisylidene-, and α-piperonylidene-methylethylketones were converted into crystalline dimers melting at 199° and 202·6° respectively.—**Hugh Ryan, W. B. Cornelia**, and **Pierse Hurley**: The condensation of aldehydes with benzyl-acetoacetic ester. Mono-substituted acetoacetic esters react with aldehydes in the presence of alkali to yield alkylidene-alkyl-acetoacetic acids and alkylidene-alkyl-ketones.—**Hugh Ryan, Peter McGeown**, and **John Keane**: Some derivatives of γ-anisylidene-methyl-ethylketone. By the action of anisaldehyde on γ-anisylidene-methylethylketone in the presence of alkali, a crystalline di-condensation compound which melted at 88°-90° C. was formed. This substance appeared to be 1-methyl-4·5-dianisyl-cyclopenten (3)-one (2). From the latter compound, by the further action of anisaldehyde in the presence of hydrochloric acid, a tri-condensation derivative melting at 158°-160° C. was formed, which was probably 3-anisylidene-1-methyl-4·5-dianisyl-cyclopenten (4)-one (2). The same compound was obtained by the action of anisalde-hyde on α-anisylidene-methylethylketone in the presence of hydrochloric acid. By the interaction of γ-anisylidene-methylethylketone with benzaldehyde and piperonal respectively, similar di- and tri-condensation deriva-tives were prepared.—**Hugh Ryan** and **George Cruess-Callaghan**: Preparation and oxidation of flavindo-genides. By the action of aldehydes on flavanone in the presence of acid, flavindogenides were obtained. Oxidation of 3-benzylidene-flavanone with potassium permanganate gave a colourless crystalline compound which melted at 163°-164° C. and has not yet been identified.—**A. J. McConnell**: The brachistochronic motion of a dynamical system. In this paper the equations of the brachistochronic motion of any dynamical system, that is, the motion from one con-figuration to another requiring the shortest time, are obtained in various forms and the geometrical pro-perties of the brachistochronic curves are discussed in the manifold of configurations.—**S. B. Wigoder** and **R. E. Patten**: Some effects of Röntgen rays on seed-lings. X-rays inhibit the growth of germinated seed-lings. In broad beans both roots and shoots are stunted, while in barley the shoots are most affected. The degree of stunting varies with the age of the bean and the part irradiated. Microscopically, the number of cell divisions diminishes three hours after irradia-tion, but usually recommences, although sometimes abnormally, after six days.

Edinburgh.

Royal Society, July 1.—**R. A. Sampson** and **A. E. Conrady**: Description of three Huygens lenses in the possession of the Royal Society of London. These three celebrated lenses, of 122 feet, 170 feet, and 210 feet focal length, which have never been examined by modern standards, were borrowed from the Royal Society for that purpose. They were examined with a plane test plate, and the interferometer; the Hartmann test was also used, and the effect of inter-posing the lens in front of a six-inch telescope of ascertained perfection. As a result the mechanical methods of figuring and centering the surfaces prove astonishingly efficient. The quality of the glass, however, is hopelessly bad. A photograph, taken according to one of Huygens' own tests, namely, the so-called 'Foucault' test of an artificial star or point source, filling the whole lens with light, shows little but a tangle of veins. Investigation of the history of these lenses confirms the conclusion of P. J. Uylenbrock in 1838 that they were made by Con-stantine, the elder brother of Christian Huygens. A photograph of the signatures of the two brothers shows clearly that the signature on the face of each lens is that of Constantine.—**W. J. McCallien**: The metamorphic rocks of Kintyre. The metamorphic rocks of Kintyre belong to the following groups, which are arranged from north-west at the top to south-east at the bottom: Erins quartzite, Ben Lui schists, Loch Tay limestone, Glen Sluan schists, Green beds, Beinn Bheula schists and grits, Skipness schists. The Erins quartzite has not previously been recognised in Kintyre and the Skipness schists have hitherto been included in the Beinn Bheula group. The Cowal anticline is continued through Kintyre to Campbeltown, where the rocks bend eastward across the strike of the fold. To the west of Campbel-town the rocks are folded into the Campbeltown syncline. The schists and limestone of northern Kintyre reappear in the Mull schists. North of Campbeltown the Loch Tay limestone advances relatively farther to the east than the other groups. The structures and unusual associates of many of the groups can only be explained with the use of slides.—**T. M. Finlay**: The Old Red Sandstone of Shetland (north-western area). A wide variety of rock types is represented in this area. A sedimentary series, mainly sandstones, is faulted against the gneiss to the north and east, forming a deep synclinal trough. These sediments are, in part, greatly altered by a later intrusive complex, the contact rocks show-ing a high degree of hornfelsing. Their exact horizon in the Old Red is indefinite, as the only fossils found in them are plant fragments too badly preserved for identification. Interbedded with the sediments is a volcanic sequence, the members of which include basalts, a rhyolite, and andesites with associated tuffs. Both augite and hypersthene andesites occur. About half the area is occupied by an intrusive igneous complex. It is sheet-like in form, and includes rock types ranging from gabbro to granite. The final phase of intrusive activity in the area is repre-sented by a system of dykes cutting the complex. These may be of widely different age.

Paris.

Academy of Sciences, July 1.—**Marcel Brillouin**: The dynamic tides of an ocean comprised between two parallels. Law of any depth in latitude and longitude.—**P. Villard**: Associations of clouds.—**Ch. Gravier**: The secondary sexual characters of *Limulus*.—**E. Mathias** and **Ch. Jacquet**: The variations of the terrestrial field at the Station du Sommet of the Puy de Dôme. The field is stronger in the day than during the night: the minimum was about 130 volts; maximum, 184 volts.—**A. Marchaud**: Continuous curves of limited order.—**Z. Horák**: The fundamental problem of the absolute integral calculus.—**Miécislas**

Biernacki: The directions of Borel of meromorph functions.—Charles Platrier: Solids with respect to which a material system is submitted only to internal forces.—Jules Schokalsky: New comparative mean levels of the White Sea, the Baltic, the Black Sea, and the Pacific Ocean.—V. Fock: The equations of Dirac in the theory of general relativity.—Stefan Vencov: The critical potentials and low tension arcs in hydrogen. The four critical potentials are given as 11·5, 13·6, 16·5, and 29·7 volts, attributed to resonance of the molecule, atomic ionisation, dissociation of the molecule and dissociation followed by double ionisation respectively.—Mendousse: Measurement of the effective wave-lengths of screens utilised in pyrometry.—Mlle. W. Czapska: The Raman spectra of the para-, ortho-, and metaxylenes.—A. P. Rollet: The precipitation of manganese dioxide by electrolysis with an alternating current. In the presence of nickel, manganese is completely precipitated as peroxide by an alternating current, and this precipitation takes place whatever the nature of the manganese salt. The precipitate was proved by analysis to be $MnO_2 . H_2O$.—G. I. Costeanu: Batteries with a fused electrolyte. The battery: copper oxide, fused caustic soda, zinc. At 400° C., this cell has, in air, an E.M.F. of 1·322 volts.—Emile Rousseau: The displacement of iodine from an iodide by an oil solution of cholesterol or of ergosterol irradiated by sunlight.—E. Rinck: The densities of liquid sodium and potassium. The experimental results found, for temperatures between the melting points and 650° C., were for sodium $d = 0{\cdot}9835 - 0{\cdot}00026(t - 96{\cdot}5°)$ and for potassium $d = 0{\cdot}826 - 0{\cdot}000222(t - 62{\cdot}4°)$. These data can be used for calculating the constant of Lorentz's law applied to the system $Na + KCl \leftrightharpoons K + NaCl$.—René Dubrisay, Jean Trillat, and Astier: Suspensions of kaolin in various media. The deposits from solutions containing soda, lime, or sulphuric acid were examined from the point of view of composition and crystalline structure.—Ch. Bouhet: The elliptical polarisation produced by reflection at the surface of solutions of fatty acids in water. The results confirm the hypothesis of the orientation of the molecules perpendicularly to the surface of the liquid, in a manner completely independent of Gibbs's adsorption equation.—J. Cluzet and Kofman: The photographic effect produced by the sterols after exposure to ultra-violet light. The experiments described do not agree with the hypothesis of phosphorescent phenomena, but support the view that the effect is due to the production of gaseous substances by the irradiation.—L. Hugounenq and E. Couture: The photochemical activity of various sterols and the nature of their action. The cause of the phenomenon appears to be chemical, possibly the formation of ozonides of the sterols.—Paul Pascal and René Lecuir: Complexes derived from triazinetricarboxylic acid.—D. Ivanoff: True mixed organo-magnesium carbonates. The author regards the name of mixed organo-magnesium carbonate for the substance MgXO . CO . R as inexact, and considers it should be kept for substances of the type MgXO . CO . OR. The preparation of some substances of the latter type is described.—A. Lepape and G. Colange: The relation between the proportions of ozone in air from the ground level and of air from the upper atmosphere.—Pierre Auger and D. Skobelzyn: The nature of the ultrapenetrating rays (cosmic rays). There are two hypotheses concerning the origin of these rays, one that they are primary and arrive directly from cosmic space, or at least from the upper atmosphere, the other, that there exists an ultra-γ radiation not directly ionising, which gives rise to the secondary β-rays observed. The observations described agree best with the latter view.—Louis Dangeard: The Foraminiferæ enveloping ooliths and pisoliths.—Edouard Chatton and Mme. M. Chatton: The state of fasting, a necessary but not sufficient condition of the experimental conjugation of the infusorian *Glaucoma scintillans*.—L. Lutz: The soluble ferments secreted by the Hymenomycetes fungi. The phenolic constituents of essential oils and the antioxygen function.—G. Ramon and Robert Debré: Attempts at the immunisation of man by means of an anatoxin of the scarlatina streptococcus.—C. Levaditi and P. Lepine: The mechanism of the natural refractory state of the lower apes with respect to the herpeto-encephalitic virus.

Official Publications Received.

BRITISH.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+85. (London: H.M. Stationery Office.) 2*s.* net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 22: On the Local Application of Radium in Therapeutics. 2: Bi-Radiant Needles. By Dr. J. Joly. Pp. 273-276. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 4, No. 3, July. Pp. 209-306. (Cambridge: At the University Press.) 12*s.* 6*d.* net.

Victoria. Report of the Advisory Committee on Cancer. Pp. 13. (Melbourne: H. J. Green.)

The Public Debts of Australia. By J. R. Collins. Pp. 24. (London: Australia House.)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929. Vol. 49, Part 3 (No. 21): The Influence of Air and Moisture on the Budde Effect in Bromine. By Dr. E. B. Ludlam and R. B. Mooney. Pp. 256-263. 9*d.* Vol. 49, Part 3 (No. 22): The Theory of Skew Determinants and Pfaffians from 1891 to 1919. By Sir Thomas Muir. Pp. 264-288. 2*s.* Edinburgh: Robert Grant and Son; London: Williams and Norgate, (Ltd.)

Indian Forest Records. Silviculture Series, Vol. 13, Part 10: Yield Tables for Blue Pine (*Pinus excelsa*, Wall.). By H. G. Champion, Parma Nand Suri and Ishwar Das Mahendru. Pp. vii+29+13 plates. (Calcutta: Government of India Central Publication Branch.) 1.9 rupees; 2*s.* 6*d.*

FOREIGN.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 83: The Hydrogen-Ion Concentration of Egyptian Soils, Parts 1 and 2. By Dr. R. R. Le Geyt Worsley. Pp. 33+12 plates. 5 P.T. Bulletin No. 84: The Effect of Locality on the Halo Length of various Strains of Egyptian Cotton. By C. H. Brown. Pp. 3+17 plates. 5 P.T. Bulletin No. 85: The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Seasons 1926–27 and 1927–28. By Dr. W. Lawrence Balls and Armenag Eff. Bedevian. Pp. 61+27 plates. 5 P.T. Bulletin No. 86: Su di un piroplasma osservato nei Polli in Egitto (*Ægyptianella pullorum*). Nota preventiva del Prof. Dott. M. Carpano. Pp. 12+3 plates. (Cairo: Government Press.) 5 P.T.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 8: Neogene Shells from some Provinces of Chūgoku. By Matajiro Yokoyama. Pp. 363-368+1 plate. 0.40 yen. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 1: Über die Anzahl der Idealfaktoren von n in einem algebraischen Zahlkörper. Von Zyoiti Suetuna. Pp. 24. 0.60 yen. (Tokyo: Maruzen Co., Ltd.)

State of California: Division of Fish and Game. Fish Bulletin No. 14: Report on the Seals and Sea Lions of California, 1928. By Paul Bonnot. Pp. 62. Fish Bulletin No. 15: The Commercial Fish Catch of California for the Years 1926 and 1927. By the Bureau of Commercial Fisheries. Pp. 94. Fish Bulletin No. 16: The Life History of the California Jack Smelt, *Atherinopsis californiensis*. By Frances N. Clark. Pp. 23. (Sacramento: California State Printing Office.)

CATALOGUE.

New Zealand. (Catalogue 518.) Pp. 34. (London: Francis Edwards, Ltd.)

Diary of Societies.

SATURDAY, AUGUST 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESS.

AUGUST 29 TO SEPTEMBER 1.

SWISS SOCIETY OF NATURAL SCIENCES (at Davos). In seventeen Sections. Lectures:—Dr. W. Mörikofer: Problems of Meteorological Radiation Research.—G. Bener: Mountain Road Construction and Science.—Prof. R. Staehelin: The Physiology of High Altitudes.—Prof. E. Guyénot: The Hypothesis of Morphological Territories in Biology.—Prof. R. Doerr: The Submicroscopic Forms of Life.

NATURE

SATURDAY, AUGUST 17, 1929.

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Craftsmanship in Modern Industry.

IN the building of the Jewish tabernacle some 3500 years ago a very high order of skill was demanded, and implied not only all manner of workmanship in metals, stones, and wood, every kind of cunning work, but also wisdom, understanding, and knowledge. The spirit of Bezaleel has persisted down to this day, and there are still clever workmen, possibly more in Great Britain than in any other country, unspoiled by excessive specialism, highly trained in hand and brain, and of dependable character. But, as Prof. Marshall has observed, skill is a very elastic and relative term, and has varying standards according to the state of general education among a people, their progress in industrialism, and their gifts of mother-wit or native sagacity.

Of late years the view has rapidly gained ground that skill, as generally understood, is required in modern industry in ever-lessening extent; the demand for it declines at an ever-accelerating pace. That the division of labour, extreme specialism, mass production, and scientific management are predominant features of industry to-day is generally taken for granted, though possibly they are not so predominant as is sometimes imagined; and in the degree to which they have been adopted there is probably no doubt that they have involved an increase in the amount of unskilled and possibly monotonous work, both absolutely and relatively. In any event, we are told that the quicker the whole of industry adopts these principles the better, unless it would perish miserably; and when these principles have been adopted, then skill, as we ordinarily understand it, will have become an anachronism. Perhaps it would be better to perish. Certainly the social effects of any substantial decline in the amount or degree of skill demanded from the whole body of industrial workers, including herein clerks, salesmen, draughtsmen, etc., would be deplorable; and there is no need here to elaborate on the philosophy of work and all that it implies in development of character and much else. The paramount need of work of the right kind for every healthy human being is well understood in all its implications.

Faced with such an apparently dark and perilous outlook, somewhat akin to that portrayed by those who speak glibly of the so-called 'machine terror', the economist and student of industry must make it his business to examine thoroughly such alleged tendencies and impressions, and, avoiding vague generalisation unsupported by tangible evidence,

endeavour to get down to a quantitative basis, secure measurable data, and so place the whole discussion on a strictly scientific footing. If economics is the science it claims to be, it should be able to do this. On the assumption, which cannot always be fully acceded, as will shortly be shown, that skill is rapidly dying out, various remedial suggestions have been made; such, for example, as more frequent change of occupation in the factory—a common practice in the Ford works; also, with or without a shortening of the hours of repetitive work, greater opportunity in leisure hours for some form of handicraft or hobby or 'satisfying' recreative work. This latter is certainly in any case a meritorious movement and should be heartily encouraged, as in Italy, where concentrated attention is now being directed to what is called *dopo lavoro*, or after-work occupation.

There are other factors which would militate against the alleged decline in the demand for skill which have not been so much consciously or purposely introduced, but have developed or evolved as industry itself has developed. But to take full advantage of these new growths, it is of course necessary to widen our definition of industrial worker to include not only the men and women in the factory, but also those in the office, for example, the clerks, salesmen, draughtsmen, and other categories. For these must be included if the aggregate amount of skill is in question, and thus at this point we are entitled to emphasise very strongly the fact that these categories have grown enormously of late years, and are constantly growing in proportion as the need for highly trained men in these different spheres becomes more keenly realised. They are characteristic of the modern age: salesmanship and publicity in the olden days were unknown or existed in a very crude form; accountancy, especially costing, the keeping of factory records, and all the multifarious operations involved in the management of a modern factory were formerly almost non-existent, but require to-day large numbers of highly skilled men. Consider also the numbers now employed in the drawing office, the research department, on intelligence and other work, and it will be realised that in the vast complexity and super-organisation of modern industry there are an almost infinite number of openings for highly trained men. The demand for such men, indeed, is often said to exceed the supply.

However, it is not proposed to make too much of these new developments, or to rely on them entirely to refute the common assumption of decaying skill. They at least entitle one to say that skill is not necessarily reduced in the aggregate, but rather changed in direction. From the point of view of the skilled or cunning workman, in cases where he has not migrated into one of the many new openings noted above, there is no doubt that in the design and manufacture of the wonderful and intricate machinery by which alone mass production is possible, the skilled workman is finding an ever-widening field; and who can say that the present form of mass production, with possibly a maximum utilisation of unskilled labour, is the final form or development of modern industry? All things industrial are in flux and transition. No doubt it is difficult enough sometimes to discern very clearly whither we are travelling. At present, industry has brought about a vast number of opportunities for unskilled work requiring little or no training, and much of this work has been taken over by women who otherwise would not go to work at all, although a few more might go into domestic service than is now the case. The position of the male workers who alone, apart at least from the textile trades, can come into comparison between the present and the past in the matter of skill is to this extent almost unchanged.

Remarkable confirmation of this conclusion, so far as it concerns an industry where mass production is predominant, has recently been given by Mr. C. G. Renold, of Messrs. Hans Renold, Ltd., Manchester, in a recent paper in the *Economic Journal*, providing that quantitative basis so much needed in these discussions. The works' records include an analysis of employees classified according to skill at three different periods—1913, 1927, 1928. Skill is used in an industrial sense and includes the black-coated groups. It implies dexterity, knowledge, judgment, and takes something like two or three years to acquire under actual experience of the job. Tables are given showing, *inter alia*, (1) increase in craftsmen category; (2) reduction in semi-skilled machine operators and unskilled labourers owing to use of more elaborate machinery giving greater output with less manning, the increased use of skilled men on such machines, and more women for unskilled work; (3) less 'upper staff' and 'male clerical'; (4) large increase in number of women employed. Other tables give interesting data as to output per worker in relation to prices and wages, showing large increase in efficiency with consequently reduced costs and higher wages.

On the whole, the outlook for the skilled worker, using this term in the wide sense which is legitimate

or industry to-day, is not nearly so hopeless as night at first sight and on superficial grounds be thought. But it is vitally important not to rest too securely on this conclusion. It is sound enough, perhaps, so far as it goes, but the complexities and reverberations of industry go deeper and further. To the social philosopher it has long been patent that skilled labour is not now quite so satisfying or so intellectually stimulating as in the past, not because it has become less in degree or extent, but because the worker himself has changed and demands more from life. Therefore in weighing the satisfaction or mental stimulus to be derived from work, it is necessary to remember that a more highly educated type of artisan, enjoying all the modern educative facilities of travel, wireless, etc., will be much more sensitive to moral and intellectual influences, prevailing currents of thought and mysteriously floating ideas, than he was in the olden days. The skill and dexterity required of him in his work will be much but not all. But still Bezaleel remains among us: the man who puts his whole heart into his work and asks for nothing more.

The March of Mathematics.

Proceedings of the International Mathematical Congress held in Toronto, August 11–16, 1924. Edited by Prof. J. C. Fields, with the collaboration of an Editorial Committee. Vol. 1: *Report of the Congress; Lectures; Communications to Sections I and II.* Pp. 935. Vol. 2: *Communications to Sections III, IV, V, and VI.* Pp. 1006. (Toronto: The University of Toronto Press, 1928.) n.p.

TWO stately volumes commemorate the meeting of the International Mathematical Congress at Toronto on Aug. 11–16, 1924. Although the receding shadow of the War caused some notable absences, yet thirty-three nations, some of them newly born, from all parts of the earth, sent some 250 mathematicians, who made 249 communications carrying over the whole field of mathematical endeavour. Six sections were the basis of the classification, four covering the ordinary range of pure and applied mathematics, and the fifth and sixth devoted to statistics, actuarial science, economics, history, philosophy, and didactics. For myself, I presided at one sitting of one of the sections, and felt strongly the truth of the description (by a distinguished scientific worker) of all such congresses, that they assembled, both in extent of subjects and diversity of tongues, the last stage of the Tower of Babel.

Eight formal lectures, however, gave valuable surveys of branches of knowledge by savants, becoming rarer every day, capable of envisaging wide fields of mathematical endeavour. The names of the lecturers, Cartan, Dickson, Le Roux, Pierpont, Pincherle, Severi, Størmer, W. H. Young, are sufficient indications of the value of these addresses. It is, perhaps, invidious to select any one of them, but what could be more stimulating and more provocative than the lecture of Dr. W. H. Young on "Some Characteristic Features of Twentieth Century Pure Mathematical Research"? I will mention only two extracts.

"In proportion as knowledge of mathematical theories has increased, the interest in purely formal work has diminished even in England, which may perhaps be said to have been its last refuge. It has begun to be understood all over the world that a mathematician is only a calculator when he must be. He is by nature a creator, a poet, not an artisan, an architect, not a mere builder."

"The question nowhere arises in Pure Mathematics whether there is anything in Nature corresponding even approximately to a mathematical concept."

Perusal of this lecture is strongly recommended both to those who agree and to those who disagree with it. It was perhaps owing to its difficulty that a similar survey of applied mathematics was not possible. To one standing outside the field of pure mathematics, it seems that Fourier's oft-quoted "l'étude approfondie des lois de la Nature est la source la plus féconde des découvertes mathématiques" requires some extension. For while it is true that many branches of pure mathematics have arisen in this way, it is also true to say that many branches seem to languish and almost die until revived by some new physical theory, for example, the impulse given to Riemannian geometry by the theory of relativity, and is it not likely that recent quantum speculations will stimulate the study of matrices, normal functions, characteristic numbers of differential equations, etc.?

Cartan's lecture on "La théorie des groupes et les recherches récentes de géométrie différentielle" may be cited as an example of this statement. In this lecture the application of the theory of groups to non-holonomous spaces must have derived much of its vitality from the relativistic spaces of Weyl and Eddington, a problem which in the last few months has again been attacked by Einstein.

An instructive lecture by Severi on algebraic geometry gave a historical retrospect of this subject, especially from the characteristic Italian point of view, which can best be described in his own words. "On tient toujours en vue le but principal qui est

d'éclaircir la théorie des fonctions par l'intuition géométrique et de viser les propriétés fonctionnelles au-dessus du symbolisme qui, quoique instrument nécessaire de nos recherches, ne doit jamais constituer leur but final."

Prof. L. E. Dickson gave us an interesting account of a fundamental generalisation of the theory of algebraic numbers. In connexion with the integral quaternions of Hurwitz, it is perhaps not generally known that Sir W. Hamilton in 1856 found the greatest common measure of two quaternions. The fascinating story of Norwegian researches on the aurora borealis was the subject of a discourse by Carl Størmer. The interesting mathematical problem of the trajectory of an electric corpuscle in the field of a small magnet is fundamental in the theory, and many of the phenomena receive their explanation in these trajectories. Simple though this hypothesis seems, the actual calculations are extremely laborious. Prof. Størmer told us that more than 5000 hours have been spent in numerical calculations! Prof. Pincherle gave a lecture on linear functional operations, showing the wide applications of these operations, and Prof. Pierpont displayed an elementary treatment of non-Euclidean geometry, starting from the expression for element of arc.

Prof. Le Roux, of Rennes, gave an account of general theorems arising out of the solution of the equation $c^2\nabla^2 v = \delta^2 v/\delta t^2$, and noted an interesting fact that if a 'source' moves with uniform velocity in a straight line, the value of the potential depends on the *instantaneous* position of the source and not on its *retarded*. Sir J. J. Thomson's original solution of the movement of an electric corpuscle gave a potential having the same property and the electric force radiating from the instantaneous position of the corpuscle. The equivalent solution of Heaviside depended on the 'retarded' position.

When one comes to the communications, a dictum of the late G. H. Bryan comes to mind, that it would be as impossible for an individual to understand everything mathematical published at the present day as it would be to understand every language spoken on the earth. There we have some 1700 pages embracing six sections. The first and second sections—algebra, theory of numbers, analysis, and geometry—occupy nearly half the whole space of the communications. Many of them were concerned with investigations arising out of the definitions of hypercomplex whole numbers, whilst in geometry the influence of the relativity theory could be seen in various directions.

Section 3 deals with the group mechanics, physics, astronomy, geophysics. Speaking generally, the tendency was in the direction of the application of extended analytical machinery to known results. The subject of quantum mechanics of the period was practically absent. The engineering section and Section 5 (Statistics) seemed very much alive; their proceedings contain important contributions to modern problems, such as aerodynamics and ballistics. Apart from specialist researches, some general papers deserve mention, such as those on the influence of mathematics on the development of naval architecture (W. J. Berry), mathematics in industrial research (Messrs. A. P. M. Fleming and R. W. Bailey), the teaching of mathematics for engineering students (Sir James Henderson), the teaching of the elements of the theory of elasticity to engineering students (Prof. E. G. Coker).

In Section 6 mention must be made of two papers by F. Cajori: "Past Struggles between Symbolists and Rhetoricians in Mathematical Publications", and "Uniformity of Mathematical Notations—Retrospect and Prospect", and one by G. A. Miller: "History of Several Fundamental Mathematical Concepts". A paper on the use of mathematics in economic, social and public statistics, by Prof. A. L. Bowley, is another of those surveys which ought to be read by all who specialise in other branches. In these days, the track of the individual mathematician is becoming narrower. He wears metaphorical blinkers in order to concentrate his aim. The benefit of a congress consists partly in the fact that such mathematicians listen to general addresses (which otherwise they would probably never read) and may derive widened outlooks showing new lines of attack. Moreover, in his own particular section discussion on a specialised paper may introduce ideas quite unknown hitherto. On one occasion the chance mention of the name Ritz in the discussion on a problem in elasticity led to interesting researches regarding this (sectionally) unknown name.

A very interesting photographic engineering supplement to Section 4 will recall to many a very enjoyable and instructive trip to Niagara and the great Queenston-Chippawa power plants. Who can forget the merriment when the trolley-car 'sat down' for want of electricity and was just able to crawl past a 550,000 horse-power generating house?

The editing of this vast work of nearly 2000 pages was done by Prof. J. C. Fields with the assistance of an editorial committee. During the Congress, Prof.

Fields was untiring in his efforts to make everything smooth for visitors. He seemed almost to possess the gift of being in more than one place at the same time, and yet found time to communicate an important paper on " A Foundation for the Theory of Ideals ". When the Congress was over, however, the real hard work commenced. Mathematicians are notoriously difficult to edit. For the most part, their work is badly organised and notations are rarely consistent. Prof. Fields (later on assisted by Prof. Chapelon) had indeed a mighty task in producing the well-arrayed volumes in question. More difficult still, the cost of printing turned out to be double the original estimate; finances had to be found. All this was, however, successfully accomplished, but, it is no secret, a heavy toll was taken of his health, research work, and his personal finances. The result is a monument to the University of Toronto and the Royal Canadian Institute, on the invitation of which the Congress was held, and to the various contributors and collaborators. Praise must also be given to the University of Toronto Press for the excellent manner in which a difficult task has been accomplished.

A. W. Conway.

Plant Pathology.

(1) *Principles of Plant Pathology*. By Prof. C. E. Owens. Pp. xii + 629. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 23*s*. 6*d*. net.

(2) *Plant Diseases*. By F. T. Brooks. Pp. vii + 386. (London: Oxford University Press, 1928.) 21*s*. net.

(3) *The Scientific Principles of Plant Protection*. By Hubert Martin. Pp. xii + 316. (London: Edward Arnold and Co., 1928.) 21*s*. net.

(4) *Lectures on Plant Pathology and Physiology in Relation to Man: a Series of Lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa, Wisconsin, the Des Moines Academy of Medicine, Iowa, and Iowa State College, 1926–1927*. Pp. 207. (Philadelphia and London: W. B. Saunders Co., 1928.) 12*s*. net.

Since the War, plant pathologists have not only done much valuable research, but also have found time to write numerous books on their subject, and library shelves which ten years ago had ample accommodation for future accessions are now cramped. The four volumes under review are, however, books for which space must be found.

(1) The work by Prof. Owens is a general text-book designed to meet the needs of undergraduate students in American agricultural colleges, but it could also be read with profit and interest by students of botany in academic institutions. It is divided into two parts, of which the first, about a quarter of the book, is devoted to a general account of the development of the science, the nature of disease in plants, and the principles underlying causation and control of disease. Part 2 is a consideration of specific diseases, classified etiologically, which have been selected for detailed study. The author takes a commendably wide view of the science of phytopathology, including diseased states brought about by unfavourable conditions of the plant's environment, and also those due to invasion by slime molds, bacteria, fungi, algæ, parasitic seed plants, nematodes, and viruses. Following the discussion of each disease are directions for its practical study and a series of pertinent 'review questions'.

The references are the weakest feature of the book, for, with few exceptions, American work only is cited. The book is finely illustrated, containing more than 200 good photographs and line drawings, many of which are original. Throughout, the author emphasises the underlying principles of the science, and one cannot help envying somewhat the students who have Prof. Owens for their teacher. There is certainly just as much true educational value to be derived from such a training in plant pathology as from the study of much that passes for 'pure science' in our teaching institutions. In spite of the American perspective of Prof. Owens's volume, it is a sound text-book and a useful addition to the literature of the subject.

(2) Prof. Owens writes from the point of view of a professor of plant pathology in a State agricultural college. Phytopathology is recognised as an independent science, having its foundations in botany, zoology, chemistry, physics, agriculture, and economics. The author is therefore concerned not merely with specific diseases, but also with the principles underlying causation and control of disease in plants and with the relation of plant disease to human welfare. Mr. Brooks's volume, on the other hand, is written from the point of view of a sometime president of the Mycological Society and a lecturer in botany in a university department, where phytopathology is not recognised as an independent science but as applied mycology, or merely one phase of botanical application.

In consequence, Mr. Brooks devotes very brief consideration to the principles and more general aspects of plant pathology, to diseases caused by

non-parasitic agencies, to preventive and control measures, and to the economic relations of the subject. His book is, in effect, a descriptive catalogue of the fungus diseases of plants with brief chapters on diseases caused by viruses, bacteria, actinomycetes, myxomycetes, and green algæ. To each of the chapters is appended a well-selected list of references.

The cataloguing is extremely well done, and, for its size, the book contains an astonishing amount of information. All the illustrations are original and some of them are good, but taken as a whole they are not of the quality of those in Prof. Owens's volume. The book is a handy compendium of the mycological aspects of diseases of British plants, and will be useful to all students and practitioners of the more comprehensive science of phytopathology.

(3) Mr. Martin's book is a detailed consideration of a field jointly occupied by phytopathologists and economic entomologists, and it is all to the good that a chemist should step in and summarise from his own point of view the data of *Pflanzenschutz*. Like Mr. Brooks, however, his purview includes only diseases caused by parasites, and the large and difficult, because diffuse and obscure, field of non-parasitic diseases, a field which in the last edition of Sorauer's "Pflanzenkrankheiten" has nearly 1000 pages devoted to it, is entirely omitted. The literature of the chemical aspects—less so of the pathological ones—has been keenly scrutinised; there are references to 116 different scientific journals, and the author index comprises seven double-column pages of names.

The book, in fact, is not merely a consideration of the scientific principles of plant protection, but is also an adequate synthesis of a considerable mass of experimental data, much of which is, otherwise, not easily accessible. The only criticism one would make is that the data are not always carefully selected. In his foreword, Sir Daniel Hall justly says: "There is a general theory of plant medicine and plant hygiene, and Mr. Martin's book is the first introduction to it that has appeared in English." The volume is essentially the contribution of a chemist to a field of research in which chemists must in the future enter more actively and personally than they have done in the past.

(4) To the more general reader the Mayo Foundation Lectures for 1926–27 on "Plant Pathology and Physiology in Relation to Man" will be the most interesting of these volumes. The contents, however, give the impression that four plant pathologists, one ecologist, and one physiologist were chosen, quite arbitrarily, and asked to give one lecture each on some subject coming within their own field of research—the particular topic not really mattering so long as it could be made to impinge on human welfare. The book in consequence has no coherent thread running through it; it is entirely sporadic, and makes no attempt to cover the field expressed in its title. The lectures vary from the nine pages of Prof. Cowles to the fifty of Prof. Coons or the fifty-eight of Prof. Stakman, and, whereas the former is a general talk, the two latter are technical essays. Both the latter equally need illustrations, as, indeed, do most of the essays in the book, yet one has sixteen excellent figures and the other none. A little judicious editing would greatly have improved this volume.

The first lecture by Dr. Kunkel on "Filterable Viruses" gives in simple language a good general notion of these obscure agents of plant disease. One is, however, surprised to hear the author bewailing his lack of diamond lenses, for there is a general impression that workers at the Boyce Thompson Institute possess such things as mere routine equipment. In his brief essay on "Ecology and Human Affairs", Prof. Cowles says some cogent things, and one could wish that more academic botanists would realise with him that "agriculture furnishes much of the best material for students of botany". The lecture by Prof. Coons on "Some Aspects of the *Fusarium* Problem" would be more congruous in a scientific journal. On the other hand, *Fusaria* are among the most destructive parasites of crops, and it is perhaps just as well that the general reader should have opportunity of gaining insight into the methods of study of parasites which exact a toll of his income. Prof. Stakman's discussion of "Racial Specialisation in Plant Disease Fungi" is noteworthy. The importance of hybridisation in the origination of new forms is at last being recognised, and there now remains to be recognised only the fact that single spore strains are not, necessarily, genetically pure. Both the latter essays contain extensive bibliographies which add greatly to their value.

Prof. Whetzel's lecture on "The Relation of Plant Pathology to Human Affairs" is a fascinating account of the development of the science. The importance of plant diseases may be realised from the author's statement that in the United States "approximately one bean in every dozen, one apple in every seven, one peach in every eight, one bushel of Irish potatoes in every twelve, and one bushel of wheat in every ten, are destroyed annually by

diseases in these crops". This very conservative estimate is probably true on average of the crops in the British Empire, and these losses are largely preventable. Such recurrent destruction of produce is scarcely conceivable in any industry other than agriculture, and if it did occur in, for example, engineering or shipbuilding, there would be no time wasted in discussing whether or not money could be afforded for research on cause and prevention; it would be provided forthwith.

Apropos of recent discussions in Great Britain on the training of biologists, one would like to quote Prof. Whetzel's forecast:

"We are only entering on the era of the professional plant pathologist. As yet most plant pathologists are employees of the State or federal government. Here and there, however, one is entering into the employ of commercial concerns interested in the control of diseases of plants: Farmers' organisations, nursery growers, smelting companies, manufacturers, and purveyors of fungicides and insecticides, and the like. The day will come when the sign of the plant pathologist will stand forth in the street alongside that of the physician and surgeon. This country can and probably will profitably support eventually more plant pathologists than physicians of medicine and surgery."

The last essay in this little volume is by Prof. Osterhout, on whom a portion of the mantle of that very great prophet, Jacques Loeb, seems to have fallen. The author deals with his illuminating researches on semi-permeable membranes, and manages to put obscure and difficult things into simple understandable language.

Altogether the book is one to fascinate any young student of botany or plant pathology, and opens to his view glimpses of the wider reaches of his subject. W. B. B.

Philosophy in Biology.

The Sciences and Philosophy. (Gifford Lectures, University of Glasgow, 1927 and 1928.) By Dr. J. S. Haldane. Pp. ix + 344. (London: Hodder and Stoughton, Ltd., n.d.) 15*s*. net.

PROF. HALDANE'S Gifford Lectures offer several points of special interest. In the first place, every reader will be struck with the reference which he makes in the preface to his older brother, Lord Haldane, and the debt of gratitude which he there acknowledges. In the second place, he gives a sufficient and illuminating account of his own researches in respiration and acclimatisation, fitting them in to his philosophic scheme. Thirdly, he has a full and most interesting account of what he understands by 'vitalism', with reasons why he does not call himself a 'vitalist'. Lastly, his lectures are the most perfect example in the Gifford series of a complete and coherent philosophy built round a definite scientific doctrine. What we have to say about the book may be conveniently grouped round these four points.

In 1883, J. S. Haldane was a medical student at Edinburgh, and a volume of "Essays in Philosophical Criticism", edited by his brother and Andrew Seth, afterwards Prof. A. S. Pringle-Pattison, appeared with contributions from both brothers. The book aimed at distinguishing the fundamental conceptions belonging to different branches of knowledge and was strongly Kantian or post-Kantian in tone. The younger brother, though a medical student, admits that his chief intellectual interest at that time was in philosophy. He had already conceived, under this philosophic influence, the bent against a mechanistic explanation of the phenomena of life which has remained with him throughout. These lectures are the mature outcome of this early training. The philosophical questions from which he started have been before his mind all through his scientific career, and he now attempts to present them as a connected whole, fortified by his scientific conclusions.

Prof. Haldane's own scientific experiments, which have filled the forty years and more since those Edinburgh days, are contained partly in ordinary scientific papers, partly in the two books "Mechanism, Life and Personality" of 1913 and "Respiration" of 1922. The results of these researches are skilfully and relevantly introduced into the chapters on the "Fate of Mechanistic Biology" and that on "Vitalistic Biology". Prof. Haldane takes his stand on the conclusion formulated by Claude Bernard that "all the vital mechanisms, varied as they are, have only one object, that of preserving constant the conditions of life in the internal environment". All the cases which he adds himself to those of Bernard are only further illustrations and corroboration of this general conclusion. Stating the matter broadly, we are forced to conclude that all the separate arrangements or pieces of so-called 'mechanism', by which the organism is kept in contact with its environment, whether internal or external, are regulated or adjusted to the right performance of their function, not by their own mechanism but by some general force, or principle, or agency, so that every part not only subserves the interests of the whole, but also is actually operated by the whole.

It will be said, of course, that this is only what is done in an ordinary man-made engine by a regulator introduced for that very purpose and that it only remains for us in each case to find the appropriate regulator in the living machine. Haldane's answer, and that, we presume, of all vitalists, would be that though we are constantly finding fresh pieces of 'mechanism', yet, pursuing this tack, we get no nearer, but rather further from, the connecting link; that life itself is the regulator.

The other great and obvious characteristic of the living being, that of reproducing itself, is clearly another aspect of the same activity. Granting, with this school of thinkers, that the maintenance and co-ordination of its specific character is the quality of life, then the prolongation of life beyond the activity of the individual follows as a part of the more general function. The special mechanisms by which this is accomplished are subordinate to the main object, just as the various mechanisms of respiration, excretion, etc., are subordinate to the general and constant maintenance of the individual being.

The third point, which we mentioned above, is probably that which will attract most criticism to the book from fellow-biologists. Why, it will be said, distinguish yourself from other vitalists when you agree with them in the substantial point, and only differ, partly from the older and crude view which no one now accepts, partly, as in the case of Driesch, from certain particular applications of the doctrine which may be mistaken without invalidating the main argument? On the whole, we think this criticism of the book and of the author's general position is sound, and that he should be ranked at least among the 'neo-vitalists'. But it is only fair to him, and interesting and enlightening in itself, to put his own ground for distinguishing his position from the vitalists as clearly and strongly as possible. It goes, in fact, to the root of his general philosophical position. He is not a vitalist in his own view, because he does not hold that we see in living phenomena some new force added to the physical and chemical process from without, but that we have in life all the physical and chemical processes taken up and looked at from another and higher point of view. The Newtonian or physical synthesis is thus abstract or provisional. We do not discard it when we advance to biology, but view the facts in another more comprehensive and higher aspect, nearer, in fact, to that highest conception of reality of which we are capable, when we take the last great step and reach the plane of consciousness. Prof. Haldane notes also that in the latest modifications of the Newtonian synthesis we seem to be approximating to the life-conception, even in the parts of our experience which we are accustomed to treat as belonging to the inanimate. On this he, while alluding to Prof. Eddington's recent volume of Gifford Lectures, wisely prefers to say as little as possible.

The last step completes the philosophical hierarchy of the scheme and brings the book into the sphere of metaphysics and religion from which, as the author tells us, he started as a young man in Edinburgh. The ideal of philosophic unity and completeness is the most striking feature of the whole work. As he began with it fifty years ago, so he comes back to it with the satisfaction and sense of rest gained from an ideal confirmed by experience. Detailed criticism of this part of the volume is more suited to other pages, but a brief indication of its purport is called for here. Just as in life we find another principle or point of view subsuming the purely mechanical, so in consciousness a still wider one completes the vital. Prof. Haldane represents this to himself as the integration of time-relations by the conscious mind as biology integrates those of space. Again we think that the biologists may find some cause for quarrel here, and again that the author may have a perfectly valid answer from his own premises. In biology we are concerned with how the organism now works; in psychology the whole process depends on memory, which involves the past, and interest, which looks to the future; and if the critic says, "But this must be true of all living things, and not only of our own minds", the author's answer is, "By all means. My philosophy contemplates life and consciousness as different in degree, but co-extensive with existence." Starting from this premise, or, if you will, this general conclusion, he breaks a lance with Smuts on holism, as he broke one with Driesch on vitalism.

The similarity of the general outlook with that of General Smuts's recent book will of course strike every reader, and Prof. Haldane admits the kinship. But he expresses strong dissent from Smuts on the point of the sudden and mysterious incursion of consciousness into the universe. If it is ever there, it has been there for ever. This stamps his philosophy and brings him at the close to his religion. The fact that so many notices, which have already appeared, find enough to say in criticising its contacts with religion, is evidence of the immense scope and profound interest of the book. It is morally inspiring, intellectually stimulating, substantially true. F. S. MARVIN.

The Parasitic Worms.

A Manual of Helminthology: Medical and Veterinary. By Dr. H. A. Baylis. Pp. xi + 303. (London: Baillière, Tindall and Cox, 1929.) 30*s.* net.

IT is rare indeed to find a text-book of general or economic zoology which treats of the parasitic worms without introducing some errors, often gross errors, although in dealing with the other phyla it may be strictly accurate. This, in the past, has been, in part at least, due to the fact that no good modern text-book on helminthology has been available. With the appearance of Dr. Baylis's work on the subject, that excuse is removed. In a matter of 300 pages, the author, briefly and concisely, provides such short descriptions of the genera and species of helminths of man, the domestic mammals and birds, as will, with the aid of the illustrations, enable the reader to obtain at least an approximate determination of most of the parasites which he is likely to meet.

The book falls into two parts, the first dealing with the flat-worms, and the second with the round-worms. Each part commences with a general account of the anatomy, then proceeds to consider, family by family, the parasites of medical and veterinary importance, their occurrence and morphology, and the more important facts of their life-histories so far as they are known. The clinical and pathological aspects of the subject are not considered and the volume is essentially a zoological one. The classification used is a natural one, so far as our present knowledge makes this possible; and in order to correlate the parasites of each host, a classified index to the parasites of the more important animals or animal groups is appended. The nomenclature used is up-to-date; but to avoid confusion with other names which have enjoyed long, though incorrect, use, the more common and well-known synonyms are usually given as well, the correct names being printed in heavy, conspicuous type.

There is no need to emphasise the importance of this subject in both medical and veterinary medicine, and helminthology is now an essential part of the curriculum of every student of these subjects, either as part of his initial training in zoology or as a separate course later on, or as both. There is accordingly a real necessity for an accurate, authoritative text-book such as this. It has its limitations; limitations set by the extent of present-day knowledge of the parasitic worms, by the omission of parasites of wild or partially domesticated animals (such as elephants and rabbits), and by the absence of pathological and clinical helminthology. To have included these, however, would have required a work of encyclopædic proportions, and correspondingly prohibitive price. Within these limitations, Dr. Baylis has done his work well and has produced a text-book of immense value, especially to those interested in zoological helminthology. The manual is well and clearly written, adequately illustrated, and strongly produced, and should meet with a ready response among zoologists, medical men, and veterinary surgeons.

Our Bookshelf.

Ibn Battúta, Travels in Asia and Africa, 1325–1354. Translated and selected by H. A. R. Gibb. (The Broadway Travellers.) Pp. vii + 398 + 8 plates. (London: George Routledge and Sons, Ltd., 1929.) 15*s.* net.

"THE Broadway Travellers" offers to the public in popular form a store of entertaining reading as well as a series of valuable records, many of which are not otherwise readily available. By including in this series the travels of Ibn Battúta, which are now for the first time made accessible to the English reader, the editors have earned the gratitude of all students of travel literature who are not professed orientalists. Ibn Battúta stands in the first rank of medieval travellers. As a Moslem he gives a picture of the eastern world which not only differs in perspective but is at the same time truer and more intimate than that of the European travellers of about his own time. Granted the difference in orientation, the general attitude of mind of this traveller is more readily comprehensible to the modern reader than that of the medieval Christian.

Ibn Battúta, who was born at Tangier in 1304, set out on his travels at the age of twenty-one. His aim was to accomplish the pilgrimage to Mecca, but he was diverted by circumstances and traversed the whole of Syria before reaching the Holy City. A visit to Iraq was followed by three years' theological study in Mecca, during which time he formed the project of visiting India, but before doing so he visited the trading stations of East Africa. Then India was reached by way of Asia Minor and Central Asia. After a stay of some seven years at Delhi he was sent as an envoy to China. When he returned to his native land after 1348 he had covered a distance estimated at 75,000 miles. He died in 1368 or 1369. The mere recital of the countries visited and the distances covered, however, gives a very meagre idea of the value of his record. His intellectual qualifications and standing as a qádi and his consequent interest in theology, combined with his intensely human personality, give his record an interest which is surpassed by no book of travel of his own and not many of a later day.

Fortpflanzung und Befruchtung als Grundlage der Vererbung. Von Max Hartmann. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 1.) Pp. ii + 103. (Berlin: Gebrüder Borntraeger, 1929.) 9·60 gold marks.

Verteilung, Bestimmung und Vererbung des Geschlechts bei den Protisten und Thallophyten. Von Max Hartmann. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 2.) Pp. ii + 115. (Berlin: Gebrüder Borntraeger, 1929.) 24 gold marks.

BAND 1 gives in compact form, and well illustrated, an account of the main phenomena of reproduction and fertilisation bearing on heredity, in the Protista and other groups of lower plant and animal organisms. Various terms not at present in general use, such as cytogony for cell reproduction, agamogony (gonidia formation), gamogony (gamete formation), gametanogamy and pædogamy are introduced. The chapter on the antithetic alternation of generations gives a useful series of diagrams in which the nuclear phases of *Cutleria*, *Scinaia*, Phycomyces, mosses, and other plants are compared.

In Band 2 the determination, inheritance, and distribution of sex in Protista and Thallophytes are described. Four types of sex determination and distribution are recognised, namely, phenotypic and genotypic determination in the haplophase and the diplophase respectively. This volume contains a very serviceable summary of the modern work on sexuality in Algæ and Fungi, much of which has not been brought together elsewhere. Scattered observations bearing on the subject in *Characium*, *Gonium*, *Gregarina*, *Actinophrys*, *Alaria*, Diatoms, and many other organisms are included. Numerous tables and diagrams in which the sexes are distinguished by colour make easy a comparison of conditions in different organisms.

Inorganic Quantitative Analysis. By Prof. Harold A. Fales. Pp. xii + 493. (London: G. Bell and Sons, Ltd., 1928.) 12*s.* 6*d.* net.

A TEXT-BOOK of inorganic analysis produced at this period which aspires to more than local interest must treat the subject from some new aspect. This object is achieved here by development from the physico-chemical side, somewhat on the lines of Bassett's "Theory of Quantitative Analysis". The scope of the present volume is, however, much wider in order that the whole field of analytical manipulation may be fully covered; for example, chapters are devoted to precision and to the theory and practice of weighing.

The exercises described are largely determinations such as are encountered practically; there are copious explanatory notes and extensive references to original sources. Electrolytic methods are described, but not potentiometric; 'gas analysis' is confined to the absorption of carbon dioxide for gravimetric purposes. The author strongly advocates the use of 'molar' solutions, abandoning the less specific term 'normal' in this connexion, but while admitting that the term 'millilitre' is desirable, continues the use of 'c.c.'. No text-book seems anxious to initiate this change.

We have read this book with considerable interest; it contains a large amount of useful information and is commended not only to the student but also to the chemist. B. A. ELLIS.

The Theory of Determinants, Matrices and Invariants. By Prof. H. W. Turnbull. Pp. xvi + 338. (London and Glasgow: Blackie and Son, Ltd., 1928.) 25*s.* net.

THIS excellent book gives a survey of a field which has come into great prominence during the present century for two quite different reasons. First, the theory of relativity has compelled physicists to extend their notions of space with the consequent necessity for formulating physical invariants appertaining to quaternary and higher forms. Secondly, the new mechanics has found a need for numbers obeying a non-commutative law of multiplication. Here the matrix representation was ready to hand. Prof. Turnbull has not made the mistake of attempting to develop the theory with an eye to its applications. Rather he has given a consistent and adequate account from the point of view of pure mathematics. Seven chapters on determinants and matrices are followed by a development of invariant theory mainly of quaternary and higher forms. Naturally in a subject of such vast extent a choice has to be made, but it will be found that the choice is extremely judicious.

The book is written in a delightfully lucid style and is admirably suited to the needs of those who wish to familiarise themselves with the mathematical concepts underlying the physical applications. To the student whose interests are purely mathematical, no better introduction could be desired. L. M. M.-T.

Jahresbericht über die wissenschaftliche Biologie: zugleich Bibliographisches Jahresregister der Berichte über die wissenschaftliche Biologie. Herausgegeben von Prof. Dr. Tibor Péterfi. Band 1: *Bericht über das Jahr 1926.* Pp. xii + 627. (Berlin: Julius Springer, 1928.) 69 gold marks.

THE editor states that the great majority of the titles in this "Jahresbericht" are taken from 1328 periodicals placed at his disposal by the publisher. The titles, each with proper bibliographical data, are arranged in sixteen sections, among which are methods, physical and chemical basis of vital processes, cytology and histology, morphology, metabolism, hormones, physiology of reproduction and development, heredity, ecology and systematics. The great majority of the titles relate to papers on animals. The index of authors and the alphabetical list of the sections of the work facilitate the rapid finding of the references to any author or subject. Some of the 7600 titles are repeated under different sections, so that the total number of titles printed is 11,500. A statistical analysis of the subjects dealt with is appended, which brings out the preponderance of works on comparative physiology (including the chemical and physical basis).

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Spectrum of Sunlit Aurora Rays as compared with the Spectrum of Lower Aurora in the Earth's Shadow.

ON several occasions, especially during the great aurora of Mar. 22–23, 1920, I have looked at sunlit auroral rays through a pocket spectroscope and always found the green auroral line very faint as compared with other strong lines in the blue and violet (Résultats des mesures photogrammétriques des aurores boréales, etc., p. 48, *Geof. Publik.*, vol. 4, No. 7). Wishing to obtain a more positive proof of this fact, I decided last winter to try to get spectrograms of these rays. I had already at my disposal some small kinema lenses of high light power and two glass prisms, one of which I had used with success to obtain prism objective photographs of aurora during my expedition to Bossekop in 1913. I was fortunate enough to get the most valuable assistance from Mr. Moxnes, engineer, attached to the physical institute of the University of Oslo. Two small spectrographs were built, one with greater dispersion but rather small light power, and the other with smaller dispersion but with very high light power.

The spectrographs were ready for use during the very interesting aurora of Mar. 15–16 last, mentioned in my recent communication to NATURE (June 8, p. 868). While Tveter, Wesöe, and I were occupied in taking photograms for determining the height and situation of the aurora, Moxnes used the spectrographs, pointing them towards all auroræ seen, especially towards all which were photographed.

Two quite successful spectrograms were obtained with the spectrograph of high light power:

(1) The first, exposed for about five hours, of all auroræ in the form of arcs, bands, rays, and curtains, during the first part of the night; the corresponding situations of the auroræ are seen in Fig. 1, to the right; they were relatively *low* and were situated in the *dark* part of the atmosphere (except one feeble ray without influence on the main result). The comparison spectrum was taken by Moxnes.

(2) The second one, exposed for about one hour, exclusively of all the *high sunlit aurora rays* just before dawn. The situation of those rays is seen to the left on the same diagram, Fig. 1, and was also given in my communication in NATURE of June 8. The spectrum with corresponding comparison spectrum was taken by Wesöe and Tveter; the exposure of the comparison spectrum was too long and therefore we have substituted a darker copy (Fig. 2, No. 2).

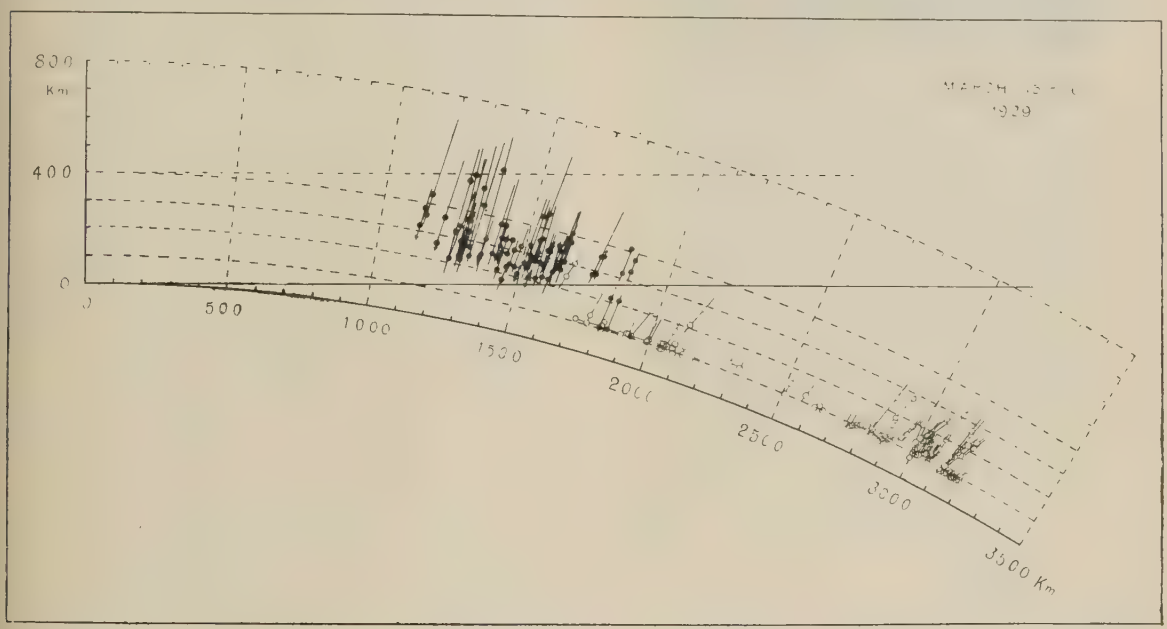

FIG. 1.—Situation of the aurora of Mar. 15–16, 1929, compared with the position of the earth's shadow. The figure represents a vertical section of the earth, and the tangent to the earth's surface is the boundary between the sunlit and dark atmosphere. The sunlit auroral rays are seen to the left, and each point calculated on them is marked by a black dot. The common aurora in the dark atmosphere is seen to the right, each point calculated being represented by a small circle.

On the night of April 16–17 last I received information from the State Telegraphic Department that earth currents were disturbing the telegraphic service. In consequence I warned all my aurora stations, and a long series of about seventy successful photograms from two, three, and four stations were secured. That night only high sunlit aurora rays occurred. Moxnes also took a spectrogram with the same spectrograph of high light power.

At my request Moxnes has here added the result of his measurements and calculations of the spectra. For details I must refer to a subsequent and more complete publication:

"The spectra were photographed on Sonia EW. plates from Herzog, Bremen, with a spectrograph of small dispersion but high light power. The light from a Hilger helium discharge lamp served as comparison spectrum.

"In the first experiment on Mar. 15–16 the slit was 0·15 mm. wide and gave rather broad lines. On April

16–17 the slit was 0·04 mm., and a spectrum with sharp lines was obtained. The spectra show the prominent lines of the aurora with wave-lengths 5577, 4278, 3914 A., and a diffuse band at 4700-4600 A.

"In spectrum No. 2, of the sunlit aurora rays of Mar. 16, the line 5577 is very much fainter than in spectrum No. 1 of the lower non-sunlit aurora of the same night, as compared with the other lines. This difference in relative intensity is very apparent when

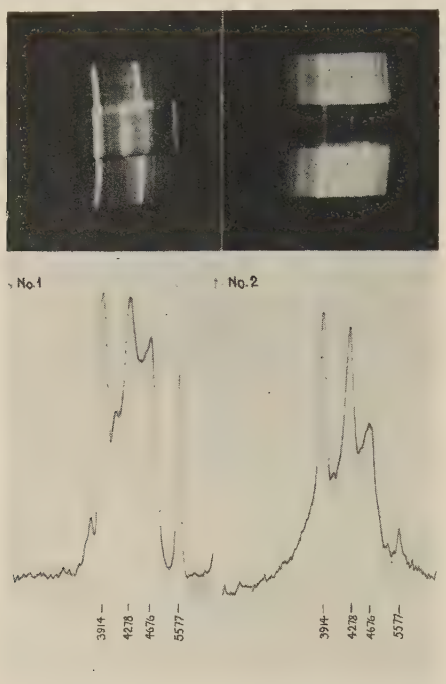

FIG. 2.—Spectrograms with corresponding photometric registrations made by a registering Moll photometer. No. 1 is of the common low aurora to the right in Fig. 1; No. 2 of the sunlit aurora rays to the left in the same figure.

the spectra are measured with a registering Moll photometer.

"The same character is shown by the spectrum of the sunlit aurora rays during the night of April 16–17."

It is thus seen from these observations that the green auroral line 5577, which is very strong for the common aurora in the earth's shadow, is very much fainter for the high sunlit aurora rays as compared with the lines of ionised nitrogen 4728 and 3914. This is in accordance with the blue and violet colour of these rays. No lines of helium or hydrogen seem to occur in the spectrum of those high rays.

These results are, however, to be considered only as preliminary. The researches will be continued next autumn.

CARL STØRMER.

Oslo.

Oyster Culture in Malaya.

As nothing is known about oyster culture in British Malaya, this note may be of interest. It is based on work done by myself while I was in charge of the Oyster Experiment Station started by the Federated Malay States Government at Kuala Kurau in Perak State. It is confined to general results, as the experiments only lasted for six months.

The locality selected for the experiment by the Fisheries Department was the mouth of the River Kurau, near Penang. Like most Malayan rivers, the Kurau courses along a soft, muddy bottom, which made it unsuitable for oyster culture under natural conditions. Two small rocky beds were, however, found in the deepest parts of the river (about seven fathoms at low tide), where oysters could be obtained, but only by employing a local diver.

All the usual methods of spat collecting were tried, but were practically unsuccessful. Crates of limed tiles were immersed and taken up and examined after a period of immersion of from three to four weeks. The tiles and the woodwork of these crates were literally smothered with barnacles, which grow very rapidly in Malayan waters, but in spite of this an average of about two spat per tile was collected. Other collecting methods employed included the letting down of ropes of brushwood, and of oyster shells enclosed in a wire-net bag, but these were no more successful than the crates, the former collecting scarcely any spat at all.

The question of relaying the spat now arose. So far as the river was concerned this proved to be an insoluble problem. A small bed (about 20 ft. × 20 ft.) by the banks of the river was selected because of its comparative firmness. This area was cultched with a lorry-load of stones and a lorry-load of mussel-shells, and the young oysters laid upon it. The rapidity with which mud was deposited soon made it obvious that the preparation of artificial beds was a futile measure. Putting the spat into small baskets let down into the river (they had to be frequently taken up and cleaned on account of the barnacles) proved more successful, but the method was merely an experimental one, and had no practical value, as adult oysters are extremely cheap in Malaya.

Another difficulty was the purification of the oysters. The river was heavily polluted with sewage, especially in the vicinity of the bed; at low tide pollution was sometimes so marked that it altered the *p*H of the water from alkalinity to 6·0 and even less. Sterilisation of the oysters in chlorinated water (the method approximated as closely to that in use at Conway as conditions permitted) proved unsuccessful. Unfortunately, the lack of equipment made bacteriological examinations at the station impossible, but samples of the chlorinated oysters were packed in a sterilised tin containing sterilised sea-water, and sent frequently to the Government Bacteriologist at Kuala Lumpur (a twelve hours' journey), with control samples of unsterilised oysters, both in sea-water and in sterile sea-water. It was found that the colonies of *B. coli* and other bacteria produced on the culture plates were generally too numerous to count, both in the chlorinated samples and the controls. As most of the Malayan rivers are similar to Kuala Kurau, this difficulty would have to be overcome by the installation of a proper chlorinating plant. The bacteriological results were extremely interesting, and it is hoped that the Government Bacteriologist will publish a short note on them.

Attempts at artificial oyster culture produced more promising results. For this purpose a solid wooden box was made, with an outflow through eighteen filter candles (the substance known as 'filtros' is more suitable, but I could not obtain it at the time). The outflow was collected in a two-inch false bottom below the candles and let out through a stopcock. The water was further aerated by mechanical agitation. In this box a few oysters were placed, and, just before the station closed down, a good fall of spat was obtained on tiles and on oyster-shells placed in the box. Sixteen large cement tanks fed with water from the river were also used for experiments. In four of

hem several hundred oysters were placed with collectors. Their outflow was very slow and was guarded with an elaborate structure of tiles, but in six months not a single spat was obtained. This may have been due to insufficient aeration and the absence of direct sunlight. These tanks were ideal, however, for relaying spat and young oysters, which thrived and grew rapidly in them.

In conclusion, I believe that oyster culture in Malaya on a commercial scale under natural conditions is not possible, though the Fisheries Department may help the native fishermen to supplement their incomes slightly by teaching them the general methods of oyster culture. Given sufficient capital and a good technical worker freed from restraint, the artificial culture of the Malayan oyster (kindly identified by Dr. B. Prashad as *Ostrea gryphoides* Schlotheim) may, however, be regarded as a sound commercial proposition. For in this work, few of the difficulties met with by artificial culturists in Europe and America occur. The climate of Malaya is warm and equable; the oysters breed throughout the year; their growth rate is extremely rapid (some spat about one month old were already 1¼ in. in length, while oysters three months old were more than 2 in. in length, and certain old specimens collected had exceeded a length of 1 ft.); the barnacle trouble can be removed by gross filtration of the incoming water; and special food can be easily supplied, as the algæ (which will be described shortly by Dr. K. Biswas) on which the Malayan oyster feeds can be readily cultured. As the Malayan oyster has a good flavour and artificially grown individuals would be superior to those found in the rivers (there is an anæmic industry at Bagan Datoh, Perak, and Muar, Johore), a demand for good oysters, at prices consistent with guaranteed purity, could easily be created by judicious advertising in the Malayan press.

Cedric Dover
(Sometime Ostreoculturist, F.M.S.).

Calcutta, June 18.

Isotope Effect in Spectra and Precise Atomic Weights.

It seems probable that many isotopes exist in amounts too small to fall within the experimental range of the mass spectrograph. This makes it desirable to seek some means of determining their atomic weights with sufficient accuracy to give reliable values of their packing effects. Two methods, of which the second appears generally applicable, will be discussed here.

In the case of oxygen isotope 17, the energy relationships accompanying the formation of this atom from a collision resulting in a combination of an alpha particle and a nitrogen nucleus with subsequent ejection of a proton, have been considered by a number of observers. Of these we will consider only the results of Kirsch (*Phys. Zeit.*, **26**, 457; 1925), which are given for alpha particles of the ranges 8·6, 7·0, 6·0, and 4·9 cm. respectively.

Kirsch, from a consideration of the initial energy of the alpha particle and the kinetic energies of the newly formed oxygen 17 and the ejected proton, finds that oxygen 17 contains 16×10^{-7}, 16×10^{-7}, 15×10^{-7}, and 15×10^{-7} ergs respectively of the energies originally possessed by the alpha particles listed above. From the relativity relation, energy $= mc^2$, the average of the four values leads to a mass of 0·0010, which is probably reliable to the last stated figure. Then the atomic weight of oxygen 17 is given by N + He + 0·0010 − H.

Birge (Suppl., *Phys. Rev.*, in press) has recently considered the available data on the atomic weights of several elements and has given values of the probable errors. The following values are given: $N = 14{\cdot}0083 \pm 0{\cdot}0008$, and $H = 1{\cdot}00777 \pm 0{\cdot}00002$. For He the value given in the table is 4·0022, but in a footnote this is corrected to the more reliable value $4{\cdot}0018 \pm 0{\cdot}0004$. Thus $O^{17} = 17{\cdot}0033 \pm 0{\cdot}0009$. This value is based on the assumption that the final state of oxygen 17, as considered by Kirsch, is the normal state of this nucleus. However, the total effect due to the energy is so small that an error in this regard would not be expected to have much influence.

In the case of oxygen 18, it has become evident that the band spectrum isotope effect can be used to give an extremely accurate value of the atomic weight.

The *A*-band of oxygen by which the existence of oxygen isotopes 17 and 18 were established (Giauque and Johnston, Nature, Mar. 2, p. 318, and June 1, p. 831; 1929; *J. Am. Chem. Soc.*, **51**, 1436; 1929) is quite insensitive to amounts of mass of the order of 0·001 gm., but can be used to establish the amount of the electronic isotope effect. This is expected to be negligible, but should be proved so. However, the *B*-band, which involves an increase of one unit of vibration during the excitation, is quite sensitive to the variation of mass. 0·001 gm. results in about 0·02 $cm.^{-1}$ in the isotopic displacement. The α-band, arising from an increase of two units of vibration, would be nearly twice as effective except that the diminishing intensity will increase the difficulty of measurement. The above method essentially involves the simultaneous use of two bands to solve for the two unknowns.

A personal communication from H. D. Babcock of Mount Wilson informs us that he has obtained excellent data on the *B*-band of the 18 − 16 oxygen molecule which will determine the atomic weight with high accuracy. It is evident that the above method is applicable to the isotopes of other elements when sufficiently accurate data become available. It is, however, limited to the intercomparison of the atomic weights of the various isotopes of a given element. From the atomic weight of an abundant isotope determined with the mass spectograph, the atomic weight of one present in very small amount may then be evaluated.

In order to utilise the isotope effect for this purpose, it will be desirable to use greater care in the theoretical treatment of the data than has previously been necessary in establishing the existence of the isotopic molecules. We have had the co-operation of R. T. Birge in this connexion, and a preliminary survey of the data indicates that it will be possible to obtain the atomic weight of oxygen 18 with a probable error in the neighbourhood of one part in twenty thousand. A joint publication will appear in the near future, based on measurements now in progress.

W. F. Giauque.

Department of Chemistry,
University of California,
Berkeley, California.

Zoological Nomenclature.

The undersigned has the honour to invite the attention of the zoological profession to the fact that Opinions 105 to 114 have been published by the Smithsonian Institution (*Smithsonian Miscellaneous Collections*, vol. 73, No. 6, pp. 1-26). The summaries read as follows:

Opinion 105. Dybowski's (1926) names of Crustacea suppressed.—Resolved: That all of the new names published in Dybowski's paper, "Synoptisches Verzeichnis mit kurzer Besprechung der Gattungen und Arten dieser Abteilung der Baikalflohkrebse"

(*Bul. internat. Acad. polonaise d. Sci. et. d. Lettres*, No. 1-2*b*, Jan.–Feb., pp. 1-77, 1926), are hereby suppressed, under suspension of the rules, on the ground that the application of the rules in accepting them "will clearly result in greater confusion than uniformity".

Opinion 106. The type of *Oestrus* Linn., 1758, is *O. ovis*.—The type of *Oestrus* Linn., 1758, is *O. ovis* (Art. 30*g*). Latreille's designation of *Oestrus equi* Fabr. as type of *Oestrus* is not valid (Art. 30*g*). The following five names of dipterous genera are hereby placed in the official list of generic names: *Cephenemyia* (type *trompe*), *Gasterophilus* (type *equi* of Clark, synonym of *intestinalis* de Geer), *Hypoderma* (type *bovis*), *Oedemagena* (type *tarandi*), and *Oestrus* (type *ovis*).

Opinion 107. *Echinocyamus pusillus* vs. *Echinocyamus minutus*.—The case of *Echinocyamus pusillus* vs. *Echinocyamus minutus* is subject to two diametrically opposed interpretations. On basis of the principle that a name in current use is not to be supplanted by an earlier but rarely adopted or an unadopted name unless the argument is unambiguous and unless the premises are not subject to difference of opinion, the Commission, because of the somewhat uncertain status of *minutus*, is of the opinion that *pusillus* 1776 should not be suppressed by *minutus* 1774.

Opinion 108. Suspension of rules for *Gazella* 1816.—Under suspension of the rules, *Gazella* Blainville, 1816, type species *Capra dorcas* Linn., 1758*a*, is adopted in preference to *Oryx*, and is hereby placed in the official list of generic names.

Opinion 109. Suspension of rules for *Hippotragus* 1846.—Under suspension of the rules (if need be), *Hippotragus* Sundevall, 1846, type species *Antilope leucophœa* Pallas, 1766, is adopted in preference to *Egocerus* Desmarest, 1822, and *Ozanna* Reichenbach, 1845 (not *Ægoceros* Pallas, 1811), and is hereby placed in the official list of generic names.

Opinion 110. Suspension of rules for *Lagidium* 1833.—Under suspension of the rules *Lagidium* Meyen, 1833, type species *Lagidium peruanum* Meyen, is adopted in preference to *Viscaccia* Oken, 1816, genotype '*Lepus chilensis* Molina', and is hereby placed in the official list of generic names.

Opinion 111. Suspension of rules for *Nycteris* 1795.—Under suspension of the rules *Nycteris* Cuvier and Geoffroy, 1795, type species *Vespertilio hispidus* Schreber, 1774, is adopted in preference to *Petalia* Gray, 1838, genotype *Nycteris javanica* Geoffroy, and is hereby placed in the official list of generic names.

Opinion 112. Suspension declined for *Manatus* 1772 vs. *Trichechus* 1758.—Suspension of the rules is declined for *Manatus* Brünnich, 1772, type species *Trichechus manatus* Linn., 1758*a*, type locality West Indies, vs. *Trichechus* Linn., 1758*a*, monotype *T. manatus*; accordingly the name *Trichechus* is to be used for the manatee instead of for the walrus. *Trichechus* Linn., 1758*a*, type *T. manatus*, is hereby placed in the official list of generic names.

Opinion 113. *Sarcoptes* Latreille, 1802, type *scabiei*, placed in official list.—*Sarcoptes* Latreille dates from 1802 instead of 1804 or 1806 as frequently quoted. It was originally monotypic, containing only *Acarus scabiei*. The 1810 type designation of *Acarus passerinus* is invalid under Article 30*c* and 30*ea*. The acceptance of *Acarus scabiei* as type species of *Acarus* is invalidated by Article 30*g*, according to which *Acarus siro* (syn. *farinæ*) is the type of *Acarus*. *Sarcoptes* Latr., 1802, mt. *scabiei*, is hereby placed in the official list of generic names.

Opinion 114. Under suspension, *Simia*, *Simia satyrus*, and *Pithecus* are suppressed. Under suspension of the rules the names *Simia*, *Simia satyrus*, and *Pithecus* are hereby suppressed on the ground that their retention under the rules will produce greater confusion than uniformity.

C. W. STILES.
(Secretary to the International Commission on Zoological Nomenclature).

Washington, D.C.

Statistics and Biological Research.

IN NATURE of July 20, "Student" propounds to me the problem of what *sort* of modification of my tables for the analysis of variance would be required to adapt that process to non-normal distributions. Since he and others evidently feel that a legitimate extension of my methods might be made along these lines, it may be worth while to point out the reasons for which, quite unusually, I disagree with his view.

The theoretical reasons may be made most clear by ignoring the limits of practical possibility, and supposing that an army of computers had extended the existing tables some two hundred fold, with the view of providing tests of significance for all distributions conforming to the Pearsonian system of frequency curves. The system of tests of significance so produced would then be exposed to criticism from three different angles.

(1) Following the lead of the reviewer in NATURE of June 8, p. 866, of my book, "Statistical Methods for Research Workers", it would be said that the new tables still needed 'correction' in order to include equally possible forms of distribution outside the Pearsonian system.

(2) A student of "Student" would surely point out that the parameters needed to enter the new tables must be calculated from the data available, and that allowance must be made for their sampling errors, by eliminating the Pearsonian parameters and replacing them by formulæ involving statistics only.

(3) A worker along my own lines would suggest that the particular statistics, means, and mean squares entering into these tests are only efficient for normal distributions, and that for Pearsonian curves quite other statistics are required, and not merely revised distributions of the familiar statistics appropriate to normal material.

The two last points could be met by dropping the Pearsonian system for one for which the moments are appropriate, when the way would lie open for the development of an analysis of the third and higher semi-invariants, bearing the same relation to the first attempt as the analysis of variance bears to some of the earlier calculus of correlations. An expert in cubic and biquadratic forms might here open out a new realm of statistical theory, for the application of which adequate data might in time be accumulated.

If the first objection is not ignored, more and more parameters may be introduced, but the patient investigator is still pursued by the analogues of these three criticisms; nor is there any doubt as to the limit of the process. It is not, as at first it might seem, the stultification of all statistical methods, but merely the abandonment of the theory of errors. Beyond all questions of metrical variates there are, largely undeveloped, a system of tests which depend only upon frequency and on order of magnitude. Examples exist in "Student's" writings, and in my own. They are free from all taint of normality, but are too insensitive to be very useful; still, their development would be of more interest than the programme of research first considered.

On the practical side there is little enough room for

anxiety, especially among biologists, who are used to checking the adequacy of their methods by control experiments. The difficulty of obtaining decisive results often flows from heterogeneity of material, often from causes of bias, often, too, from the difficulty of setting up an experiment in such a way as to obtain a valid estimate of error. I have never known difficulty to arise in biological work from imperfect normality of the variation, often though I have examined data for this particular cause of difficulty; nor is there, I believe, any case to the contrary in the literature. This is not to say that the deviation from "Student's" *t*-distribution found by Shewhart and Winters, for samples from rectangular and triangular distributions, may not have a real application in some technological work, but rather that such deviations have not been found, and are scarcely to be looked for, in biological research as ordinarily conducted.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, July 26.

Nuclear Association in the Æcium of *Puccinia graminis*.

IN a letter to NATURE (July 23, 1927, p. 116) Craigie announced the discovery of heterothallism in the rust fungi. In a second letter (Nov. 26, 1927, p. 765) he showed that the æcial stage of *Puccinia graminis*—the parasite which causes the black stem rust disease of cereals—can be produced on the leaves of the common barberry at will simply by applying to the pycnia of a monosporidial pustule of one sex some of the pycniospore-containing nectar excreted from the pycnia of another monosporidial pustule of opposite sex.

A series of experiments on *Puccinia graminis*, recently made by me, has yielded some information as to the manner in which the change from the haploid to the diploid condition in this fungus is brought about.

The sporidia are uninucleate. In a pustule of monosporidial origin, the mycelium and the pycniospores produced by the mycelium are also uninucleate. In such a haploid pustule there appear, near the lower epidermis of the barberry leaf, numerous sterile wefts of mycelium. These wefts, which appear to be crescent-shaped in transverse sections of the leaf and are made up of hyphæ with uninucleate cells, are evidently haploid rudiments of æcial cups waiting to be stimulated into further developmental activity.

When nectar which contains pycniospores of one sex is applied to the pycnia of a monosporidial pustule of opposite sex, the wefts of hyphæ situated along the base of the pustule soon undergo a change from the haploid to the diploid condition. About 48 hours after the pycniospores have been applied, the nuclei at the base of each weft become enlarged. Neighbouring hyphæ then fuse in pairs in a manner similar to that described by Christman for *Phragmidium speciosum*, and two nuclei become associated in each fusion cell. The fusion cells, which initiate the diplophase, elongate and cut off chains of binucleate cells which later divide and thus form intercalary cells and æciospores. Sections through pustules fixed 65 hours after the application of pycniospores have shown young æcial cups with as many as four æciospores in several of the æciospore chains.

The part which the pycniospores play in bringing about æcial development is not yet completely understood. Some of the pycniospores have been observed to germinate, and, in one instance, the germ-tube from the spore had attained a length of 15 μ. In view of the fact that binucleate hyphæ are to be found only at the base of the æcium, it seems probable that, when pycniospores of one sex are applied to a pycnium of opposite sex, the pycniospores are stimulated to germinate and to produce haploid hyphæ which grow down to the hyphal wefts near the lower epidermis and there fuse with cells of opposite sex. The solution of the problem of tracing the hyphæ from the germinating pycniospores to the base of the æcium must await further investigation.

W. F. HANNA.

Dominion Rust Research Laboratory,
Winnipeg, June 24.

The Crystal Structure of Solid Nitrogen.

RECENT researches on the luminescence of solidified gases have shown that systems consisting of mixtures of nitrogen with inert gases give a great variety of oscillatory bands, which are intimately connected with the oscillations which the nitrogen atoms are able to perform in the crystalline state. As pointed out in previous papers, the determination of the crystal structures of these systems will be of fundamental importance for the interpretation of the oscillatory bands characteristic of the solid state.

Researches on the structure of solidified gases have already been taken up by W. H. Keesom and his collaborators at the Cryogenic Laboratory of Leyden (*Comm.*, Leyden, 178). For pure argon they find a face-centred lattice. In the case of nitrogen, which is the most important substance for our purpose, they merely state that they have obtained powder diagrams, which, however, are so complicated that they have not been able to interpret them by means of a definite unit cell and a corresponding crystal system.

As the oscillatory bands mostly originate from nitrogen, it is indeed the nitrogen structure which is of the greatest importance for the interpretation of the luminescence phenomena, and we have therefore also attacked the problem at the Physical Institute of Oslo. We obtained good powder diagrams with a conveniently constructed apparatus, and after having tried a number of crystal classes, we finally succeeded in showing that the spectrum could be interpreted by a unit cell belonging to the cubic system.

The side of the unit cube was found to be 5·65 A. units, and the density measurements of Dewar lead to the result that the unit cell contains 8 nitrogen atoms.

In these investigations I have been most ably assisted by Mr. Alf Maurstad, Mr. S. Stensholt, and Mr. E. Tønsberg.

L. VEGARD.

Physical Institute, University,
Oslo, June 28.

Nature of Disease-Producing Viruses.

TWICE recently I have noticed in the columns of NATURE criticism of the hypothesis that disease-producing viruses are intermediate between molecule and living cell because no non-parasitic forms are known. Until viruses can be known other than by the effects of their parasitism, it would seem to be quite impossible to detect corresponding bodies that are not parasitic. I agree with the critics that if such bodies exist they may be much more numerous than the viruses, but until some method is devised by which the constituents of the viruses can be recognised, it would seem to be useless to look for them. For the hypothetical intermediate combining molecular structure, metabolism, and reproduction, I have been using the designation *vitamol*.

J. J. DAVIS.

Department of Botany,
University of Wisconsin,
Madison, Wisconsin, U.S.A.,
July 9.

South Africa's Contribution to Prehistoric Archæology.[1]

By HENRY BALFOUR, F.R.S.

THE interest which is manifested in the study of the early chapters in the story of man's culture development is steadily increasing, not only in intensity but also in range, and there are now but few regions which remain totally unsearched for traces of early man and of his material activities. Interest becomes more *intense* as the scattered material is found more and more to belong to one huge complex problem, and it is realised that each scientifically collected item has a place in the cosmic mosaic, and may be the means of illuminating what has hitherto been obscure. The ever-increasing geographical *range* of this interest results largely from the discovery that from most parts of the world there may be collected data having a bearing upon these problems, and that it is profitable to search for traces of early man in almost any area which has ever been habitable.

Unfortunately the exceptional opportunities for study which have been offered by recent primitive peoples have largely been neglected, and the scientific value of close research into their material culture has usually not been recognised until it was already too late to reap the full benefit of the harvest. Civilisation has been more concerned with the extermination or rapid metamorphosis of primitive peoples and their industries than with their scientific investigation; and it is one of the tragedies of prehistory that so much of the invaluable and once accessible material should have been allowed to die away unstudied.

In the history of South African colonisation there may be noted such a failure to seize an opportunity of investigating fully a living primitive culture which might have thrown much light upon culture-details of long-vanished peoples elsewhere. The Bushmen and their kindred afforded an example of persistence of palæolithic conditions into recent times. Their culture was a purely Stone age culture, and they made and used stone implements of types many of which recall forms of implements which prevailed during the earlier section of the Late Palæolithic culture phase of western Europe and North Africa. The functions of the implements of the ancient series have been diagnosed so far as possible, and terms have been assigned to them, indicative of their presumed uses; but this is largely guesswork. Some degree of certainty, however, might have been reached had the living users of identical types of tools been closely studied, while the opportunity lasted, and had the details of manufacture and use of the various tool-types been placed on record.

It is too late for that record ever to be made complete and, from an archæological point of view, enlightening. Dispossessed of their old hunting-grounds, the miserable remnant of the once virile and widely dispersed Bushman race is rapidly passing away under environmental conditions so altered from those formerly enjoyed, that but little light can be thrown by the struggling survivors upon the true characteristics of Bushman culture. The old camp-sites, now deserted, must be investigated archæologically; and, in diagnosing the relics discovered, inference must take the place of direct observation.

Even that most striking feature of all, among Bushman relics, the rock-paintings and engravings, some of which are of very recent date, must be studied archæologically, on similar lines to those pursued in the interpretation of the strikingly similar artistic achievements of Aurignacian and Madeleinean man in France and Spain. How greatly would the interest of this prehistoric art in Europe have been enhanced if only a fuller comprehension of Bushman art had been arrived at by direct observation of its processes and functions. The artists have gone; this chapter in art-history is now closed, and there can be no period of *Renaissance*.

At the same time, while we must admit that the ethnological record is far weaker than it should be, through lack of scientific observation on the part of those pioneers who had opportunities of detailed study, we can note with great satisfaction the steady growth in South Africa of a keen interest in the archæological problems with which the country teems. The progressive development of local attention to the study of the Stone age in South Africa, the increasing desire for the establishment of a time-sequence of culture phases, coupled with the adoption of more precise scientific procedure in research, are features in the intellectual activity of the region the progress of which towards maturity I have myself to some extent been able directly to observe and follow.

My first visit to South Africa in 1899, exactly thirty years ago, revealed to me that, although a definite start had been made and collectors were in the field seeking for relics of the Stone age, this pastime was restricted to comparatively few enthusiasts, and the search was of a somewhat desultory nature, conducted without strict method or well-defined perspective outlook.

My second and third visits, in 1905 and in 1907, showed me that there were already many workers in the field, and that increasing attempts were being made to study the finds stratigraphically and to classify them in accordance with sequence dating. Still, the work of correlation was hampered by imperfect acquaintance with the results arrived at by European archæologists. This limitation led to some deductions which were scarcely justified by the facts.

In 1910 I again found myself in South Africa—by invitation of the South African Association. It was at once manifest that there was an increasing recognition of the importance of the geological associations of the earlier types of stone implements, as a means of establishing their relative antiquity and the ordered sequence of their succession. More serious attempts were being made to investigate

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Johannesburg on Aug. 1.

ancient alluvial deposits and to record the particular strata from which implements were derived, and the depth within the strata. The archæological collections in the various museums were beginning to be grouped and arranged so as to tell a definite story—the story of the occupation of South Africa in early times by successive waves of immigrants, each wave introducing more or less distinctive culture elements. In this way the museums were not only attempting to furnish a summary of local archæological phenomena as interpreted up-to-date, but they were also offering suggestions as to the aims and objectives of future field-research, and indicating the nature of the problems awaiting solution.

This year it is my privilege to renew acquaintance with South Africa, the attractions of which, be they scenic, zoological, archæological, or ethnological, ever draw me with magnetic force. It is a very great pleasure to note the strides which have been taken since my last visit, nearly twenty years ago, towards unravelling the local archæological complex, and to note that this pursuit of knowledge is conducted on increasingly methodical and scientific lines.

It is manifest that the vast African area lying to the south of the Zambezi holds almost unparalleled wealth of archæological material. It appears as an inexhaustible mine of ancient relics. This is probably largely due to the successive waves of immigrant peoples having arrived in early times from the north. South Africa, though spacious, is a *cul-de-sac*, a land-terminus beyond which stretches the southern ocean, which arrested any further southward dispersal. We must picture the arrival, one after the other, of primitive peoples in various stages of culture advancement, and it is natural to assume that the order of their arrival in the far south is indicative of their general culture status. The more undeveloped peoples, less capable of defending their rights and of holding their own, yielded to the pressure of the more progressive peoples, before whose advance (due probably to similar causes) they gave way, eventually being forced down into the *cul-de-sac*, where abundance of game animals, no doubt, afforded compensatory attractions, and where they could establish and maintain themselves unmolested, until a new immigration brought a fresh racial stock into the region and renewed the clash of cultures.

During long ages, this sequence of irruptions of peoples inevitably induced a resultant congestion of heterogeneous ethnic elements, the weaker units continually giving way to the stronger, who, it may be reckoned, partly absorbed and partly exterminated the earlier occupants. The existing cultures must, at least, have been influenced and altered through contact with the new. Thus it is not difficult to see how, through a long sequence of immigrations into a region devoid of outlets, vast quantities of the more imperishable culture relics came to be accumulated in South Africa. It is also clear that the inevitable overlapping of cultures, coming into enforced contact in this Ultima Thule, tended to result in not only fusion but also confusion, and to bring about complex, hybrid industries, the parentage of which it is the aim of local archæologists to unravel.

The process of sorting out the data, and of classifying and evaluating the Stone age cultures represented in South Africa, is now proceeding apace, thanks to many keen research workers. Already several new names have been at least tentatively adopted for denoting various differentiated industries, which have been provisionally assigned their places in the chronological series.

This valuable archæological mine has as yet been only partially exploited, but its potential wealth is unquestioned; and, although prehistoric archæology must rank as a 'pure' science, and cannot be regarded as one which materially increases the *financial* welfare of the community, the finds which its pursuit brings to light must be regarded as a valuable asset to the country, worthy to be ranked with gold and diamonds and other commercially productive assets.

The great scientific importance of this valuable heritage imposes certain responsibilities upon the administration. Organisation in research is very desirable, and, although it is undesirable to curb the enthusiasm of untrained collectors, who may help very materially, it is to be hoped that, so far as possible, the field-work may be conducted under the advice and, when possible, the *surveillance* of properly trained and qualified archæologists, who may ensure that scientific methods will be pursued. This will render the finds collected more reliable as evidence, suitable for co-ordination, and capable of serving as material for building up the early human history of the region. The appointment of a carefully selected advisory committee would appear to be a practical measure, and might prevent much unprofitable work.

Surface finds are very frequently of importance to the prehistorian, particularly when accurately localised, but it must be remembered that their interest is *derived* and not intrinsic. Their value to science depends upon the possibility of comparing them with similar types the chronological horizon of which has been ascertained with certainty from their position in undisturbed stratified deposits. Material, form, technique, patination, and abrasion, all have their significance when surface finds are collated with those of determined provenance.

When one is engaged in research work there is undoubtedly a fascination in following up a theory already formulated, and in seeing the newly discovered material fitting into the theory and supporting it. But it must be admitted that there is danger in this attractive procedure, since preconceived ideas tend to restrict and cramp the outlook of the investigator and to bias his mind, causing him to overlook evidence which may be of considerable significance. At the present time it is not so much abstract theories that are wanted as concrete facts—unassailable facts, ascertained by close scrutiny of ancient alluvial deposits upon ancient camping sites, in caves, under rock shelters, and so on. From these in time will be established

the relative antiquity, sequence position, and characteristics of the early industries represented in South Africa; their geographical dispersal, the probable routes of their migrations and their inter-relationships. Also the effects of the successive impacts of newly arrived cultures upon those already established in the region will be rendered clearer when more detailed and precise data have been secured and can be co-ordinated.

Problems still awaiting solution abound in South Africa and call for the onslaught of skilled and unbiased investigators, who are prepared conscientiously to modify and even jettison theories already propounded, if new facts call for this sacrifice.

One of the problems in which I am myself keenly interested is that afforded by the Stone age remains which are so abundant along the Zambezi and its tributaries in the neighbourhood of the Victoria Falls. The first stone implements from that district to be brought to notice were, I believe, collected by Mr. A. J. C. Molyneux; but many others have since been obtained on the spot by Dr. Lamplugh, Mr. Franklin White, Colonel Feilden, and others. In the course of three visits which I have paid to the Victoria Falls—in 1905, 1907, and 1910; collectively amounting to a stay of thirty-seven days—I collected some 1200-1300 implements and artificial flakes or chalcedony and quartzite. The numerous well-defined implements are, with very few exceptions, of pronounced Lower Palæolithic facies, Chellean and Acheulean, and, but for the material of which they are made, they might almost as well have been obtained from the terrace-gravels of the River Thames or of the Somme. That is to say, in form and technique they are absolutely comparable with types which characterise the 'River drift' cultures of western Europe. They might be taken to indicate a late survival of these culture phases which had persisted until relatively recent times on the periphery of their dispersal. Or they may be regarded as an independent genesis of similar cultures, unconnected with the northern series, and evolved in response to similar environmental dictates. But evidence of very considerable antiquity is afforded by the implements themselves, which are often heavily abraded and patinated and frequently very highly glazed.

Still more important is the position in which many of the implements are discovered. I have found some imbedded at various depths in old alluvial deposits along the banks of the Zambezi, and of the Maramba and Masui tributaries; others were associated with or imbedded in thin gravel drifts scattered over the bare basalt plateau below the line of the Falls. This plateau is the ancient bed of the Zambezi over which the river flowed before, by gradual recession of the Falls to their present position, the upper portion of the Batoka Gorge had been eroded.

If we are justified in assuming that the implementiferous gravel drifts distributed over the ancient river bed and now lying 400 ft.-600 ft. above the present level of the river in the gorge, were deposited there by the Zambezi itself, then there is direct evidence not only of antiquity, but indeed of extremely high antiquity. Lamplugh, who carefully surveyed the Batoka Gorge in 1905, A. E. V. Zealley and several other skilled geologists have expressed themselves more or less decidedly in favour of this view, which certainly coincides with my own impressions. Assuming this impression to be correct, it is evident that, since these gravel drifts, with some of their associated artefacts, were deposited upon the ancient river bed, the river has eroded out a channel to a depth of from 400 ft. to 600 ft. through solid basalt. The great depth of this wonderful gorge affords data for estimating the time required for this gigantic work of attrition, while the extent of the canyon above the gravel drifts supplies further measurable time data.

Now, such important evidence of man's antiquity in South Africa deserves very careful scrutiny. It is worth while establishing once for all and conclusively whether the gravels referred to *were* laid down by the Zambezi itself, and not by lateral spruits. In spite of the prevailing geological opinion, one must recollect that Dr. Codrington, and possibly some others, did not accept this view, and, while any possible doubt remains, further investigation is called for by highly competent geologists, who can make an authoritative pronouncement.

The detailed geological diagnosis of the implementiferous terrace gravels throughout the South African region would be of great benefit to archæologists, who are endeavouring to group the early stone implement types into a time scale sequence. Some good work has already been done, but further research is needed before the succession and inter-relationships of the earliest cultures can with confidence be demonstrated.

One of the most interesting questions for local archæologists to answer is the true culture horizon to which the industry of the so-called 'Still Bay' culture should be assigned. It is characterised chiefly by the fine and shapely leaf-shaped blades, many of which are flaked all over with considerable skill. These form a decidedly specialised group. The industry appears to be somewhat local and not to be widely dispersed. It was one of the earliest distinctive industries to be noticed, and came into prominence so early as 1866, when Dr. Langham Dale collected many examples upon the Cape Flats. One wonders, in fact, why Still Bay should be regarded as the 'type site' of this culture, since, by the rules of priority in nomenclature, the designation 'Cape Flats' industry would appear to be more appropriate, in recognition of Dr. Dale's pioneering discovery. But this is by the way. By some, the dominant implements of this industry have been taken, on insufficient evidence it seems to me, to indicate a Solutréan phase in South Africa. J. P. Johnson described the leaf-shaped blades as 'Solutric', and L. Peringuey refers to them as exhibiting a 'Solutrian *facies*', though there is a non-committal touch in his expressed opinion. The chapter which deals with this industry is headed 'The Neolithic'!

It appears to me that the technique of the leaf-haped Still Bay blades differs considerably from hat of the typical Solutréan blades of western Europe, and scarcely justifies any confident sugges-ion of affinity. It will be extremely interesting vhen the exact status of the 'Still Bay' or 'Cape Flats' culture is established, and when it is known vhether it was evolved locally from a previous ndigenous culture; or whether its origin is due o 'mutation', as a result of culture-fusion; or, gain, whether it represents an intrusive culture vhich had been differentiated elsewhere.

Another intriguing problem has as its focusing oint the *'kwè*, the stone digging-stick weight of he Bushmen. Although this is one of the best-nown implement types in South Africa, and one f the most widely dispersed, it presents one of he greatest puzzles. Judged by the standard of Europe and of most other parts of the archæological vorld, the perforated stone ball known as *'kwè* eems to be out of place in the hands of a people vhose culture largely suggests palæolithic affinities. The art of perforating implements of hard stone vas, in Europe, a late development and it does ot appear to have become prevalent until the ater phases of the Neolithic period. Hence, there s a suggestion of precociousness on the part of he Bushmen, whose general status scarcely varranted their possessing or, at any rate, making erforated stone tools. The question as to how hey came by this technique is one which is not eadily answered.

A possible solution occurred to me many years ago, vhen I ascertained that another people, occupying n area in north-eastern Africa, employ a practi-ally identical implement—to wit, a simple digging-tick heavily loaded with a perforated stone weight, hrough which the stick passes. These people re the Gallas, a Hamitic people domiciled to the outh of Abyssinia. Being in a relatively advanced tate of culture, *their* employment of perforated tones is not in any way remarkable. But their se of this stone-weighted digging tool does suggest he possibility that, in the course of their south-vard drift, some of the Bushman hordes may have ome into contact with the Gallas, or kindred eoples, and have acquired from them a knowledge f this tool, and of the technique involved, and ave carried with them into the south a borrowed dea which was destined to become an anomalous hough prominent feature in the so-called 'Wilton' ndustry. That they should have invented the *kwè* for themselves is contrary to analogy, and he fact that an identical appliance, used in a imilar manner, occurs among a people in the north, t least offers a possible explanation of the seeming aradox.

The existence in South Africa of the *'kwè*, with ts marked *neolithic facies*, is rendered the more triking when we remember that implements of listinctively neolithic character are rarities in frica to the south of the Zambezi. Ground stone elts, for example, are of very uncommon occur-ence, and the same applies to the typical late Stone ge arrow-heads, locally found examples of which probably scarcely exceed half a dozen in number. Other characteristic neolithic types are conspicuous by their absence in the region. In the local sequence of cultures the typical late Stone age appears to be missing, or at least so faintly represented that it cannot be regarded as ever having exercised a dominating influence. At best, the latest purely Stone age culture definitely represented in South Africa suggests a general Upper Palæolithic and Mesolithic level modified by a very slight infiltration of neolithic intrusion, and no marked invasion of a people possessed of a culture at all comparable with that of typical neolithic man in the north seems to have occurred.

When the great succession of invasions of Bantu peoples was inaugurated, the newcomers were, presumably, already well advanced in their Iron age, and had long since passed out of even the latest phases of the Stone age. Hence, so far as South Africa is concerned, the transition from Stone to Iron was remarkably abrupt. There is a marked hiatus due to the absence of linking cultures between a late Palæolithic phase, somewhat modified by intrusive ideas, and an already evolved phase of metal. The fact that the later arrivals upon the scene—with their superior physique and their knowledge of working iron—were vastly superior to the peoples whom they overran and succeeded in dominating, must have created a sudden and far-reaching change in the general economic development of the region. The unbridged culture hiatus is a wide one, and is one of the striking features in South African history.

The earlier nomad hunters appear to have been gradually forced into their final southern home, and to have remained for a long time in a state of partial stagnation, undergoing comparatively little progressive evolution. To a considerable degree the industries which were successively introduced by them offer analogy to some of the early Stone age industries which have been differentiated and standardised in Europe, and furnish the obvious basis of comparison in prehistoric archæology. In all probability the early cultures of South Africa may, for the most part, be regarded as related to and as offshoots from those the sequence status of which has been determined in the north.

One cannot expect the resemblance between the European and the South African series to be very exact, however, since it is highly improbable that their occurrence in the two widely separated regions synchronised. A migrating culture, even the most unprogressive, cannot long continue unchanged. It is plastic and reacts to new environmental conditions, which create special wants and impose modifications. New elements appear in response to new demands, and some of the old characteristics vanish as their utility ceases. On the periphery of its dispersal an industry is, in fact, liable to show marked differentiation from its original prototype. Certain elements in the complex persist, and continue to supply evidence of affinity with distant cultures: but the points of divergence are no less interesting, since they illustrate the effect of the new environment upon

the habits of the people. South African archæology intriguingly suggests culture affinities, far-ranging both in time and in space, and illustrates at the same time how those affinities have become more or less obscured and attenuated in the course of long migration.

At present the South African problems have to be studied to a great extent as a group of isolated phenomena, because a vast area to the north remains, archæologically, almost unexplored. Northern Rhodesia, Nyasaland, and Tanganyika Territory, when the story of *their* ancient cultures has been fully revealed, should throw a flood of light upon South African archæological peculiarities by furnishing evidence of the migrations routes and of the gradual changes in culture detail resulting from the dispersal southward. Farther north, in Uganda and Kenya Colony, important and suggestive work has already been carried out by Mr. E. J. Wayland and Mr. L. S. B. Leakey, the results of which have an important bearing upon the South African problems. But the full import and significance of the north and south affinities and dissimilarities will be realised when the huge intervening area has revealed its archæological secrets and contributed its data for a valuable chapter in the story of the wanderings and sojournings of migrant peoples in the course of their progress southward.

In the meantime, South Africa may well concentrate upon her local prehistoric problems, and proceed with the exploration of her past and the disentanglement of her sequence of bygone industries.

Such research into the past is surely worthy of every encouragement from the universities, and deserving of government benediction and even financial support. The material appears to be extraordinarily rich, almost inexhaustible in fact, and the deductions drawn from carefully verified data in one district can be checked and re-checked by information culled in others, so that the final summing-up should prove authoritative and highly instructive.

Tung Oil.

TUNG oil is an essential raw material of present-day varnish manufacture, and in fact its unique properties render it indispensable for certain types of varnish. Until comparatively recently, China has satisfied the world's demand for tung oil, and will, it is considered, continue to remain the chief source for some years to come. The oil is derived from two species of *Aleurites*, *Fordii* and *montana*, of which the former is the chief source. It was Wilson, a naturalist in western China, who in 1915, after a study of the species of *Aleurites*, solved the question as to the true origin of tung oil. *A. Fordii* has its habitat chiefly in western and central China, whilst *A. montana* is found more to the south. Tung oil, also termed China wood oil, was known outside China about 1760. It was first introduced into the United States in 1896, into Germany in 1897, and soon afterwards into England. Little notice of it was taken commercially in England until after the outbreak of War, when special water-resisting varnishes were required for aeroplane work. Thereafter, on the recommendation of the Raw Materials Committee of the Imperial Institute, growing experiments (Wilson having stated that he considered the trees could be grown in South Africa, East Africa, Australia, Algeria, and Morocco) were started in India, Ceylon, Malaya, Burma, Kenya, Tanganyika, Hong-Kong, and South Africa. The position of this new industry was first reviewed in a paper prepared by Dr. L. A. Jordan, of the Research Association of British Paint, Colour, and Varnish Manufacturers (Technical Paper, No. 1), published by the Association for private circulation in 1927. The work described proved of such importance and aroused such interest that the paper has been now republished, after a revision, by Dr. Jordan (*Journal of the Oil and Colour Chemists Association*, Vol. 12, No. 107, May 1929).

In China the tung oil trees, with reference principally to *A. Fordii*, occur abundantly and grow luxuriantly mostly in a region between Lat. 26° and 34° N., and in hilly country up to 2500 ft. in altitude, especially in the upper reaches of the Yangtze valley. *A. Fordii* favours the northern and *A. montana* the southern parts of the area, but there is no strongly marked division in the distribution of the species. They are ornamental trees and rapid growers producing fruit, from which the oil is extracted, in and after the third year—though it is safest to calculate on a first crop as from the fifth year. In China the trees generally grow to 20 ft.-25 ft. in height, with a trunk of about 10 in. in diameter. But individuals are said to attain 50 ft.-60 ft. with a canopy 60 ft. in diameter. The trees have a low branching habit and pruning is necessary to prevent a low straggling cover. The fruit is about the size and appearance of a russet apple. The blossoms are very sensitive to early spring frosts, and young trees, until established, are subject to frost. For other details on the manner of growth and cultivation the reader is referred to Dr. Jordan's publication. Of greater interest here is the progress made in the cultivation of this valuable tree.

As has been said, the world was dependent on China for the oil. The United States, the post-War consumption of which went up by leaps and bounds, were the first to realise the position and to take steps to obviate a total reliance on one source of supply and country. In 1914 the U.S.A. imported 61 per cent of the total Chinese export, in 1918, 77 per cent, and in 1925, 80 per cent. The American consumption is now 40,000 tons per annum. The oil is used to a considerable extent for domestic purposes in China, and the increasing world demand will encroach more and more on the stocks required for home use, which will mean that they will only be parted with at an increased price. The methods of collection and extraction of the oil in China are crude and wasteful, yet the crop is regarded as a most profitable one by the Chinese.

It was these considerations which led the Americans, very soon after the War, to take up the question, added to the fact that they were reluctant to depend for their supplies on a foreign country. They began to study the possibilities of establishing a domestic industry; a period of high prices in 1923 brought the matter to a head, with the result that the American Tung Oil Corporation was formed with Mr. H. A. Gardner, the Director of the American Paint Research Institute, as vice-president and general manager. "British Paint Manufacturers stand to-day", says Dr. Jordan, "precisely where the Americans stood about 1921". The object of the Corporation has been to demonstrate primarily what could be done with tung oil trees as a crop in the hope, which has been fulfilled, of encouraging farmers to cultivate the tree on a large scale upon a commercial basis.

Judged from the manner in which this work is developing over a very wide area in the southern United States, and also in Hawaii and the American Pacific Islands, it has become evident that the farmers have responded to the efforts of the Corporation. In 1923 all the information available in America was that a few tung oil trees had been successfully grown here and there in various parts of the southern United States, the oldest of these trees being about 14 or 15 years at that time. The Corporation acquired land adjacent to the Agricultural Experimental Station of the University of Florida, and the first seedlings were planted in 1924. By 1926, 2500 acres had been planted up, representing about 200,000 trees. Distribution of one-year plants raised in nursery centres is made on very favourable terms to bona-fide farmers. In the autumn of 1926 the Corporation had half a million seedlings in the nurseries available for distribution. The Corporation is assisted by the U.S. Department of Commerce, and everything is being done to stimulate the independent planting of the tung oil trees. Seed is now being sold from the nurseries to large landholders, and several hundred pounds of seed were shipped in 1927 to New Zealand, Jamaica, the Virgin Islands, the Philippines, and to England for Colonial purposes. In the Report for 1928 the area under tung oil trees amounted to 4000 acres, whilst another 1000 acres was projected in Florida during 1929.

Experiments have been made as to the best machinery for crushing the seed, 30,000 lb. of seed being experimented upon in 1928. In January 1929, the first large-scale tung oil mill came into operation, capable of expressing about 50 gallons of oil per hour; this marking the commencement of activities on a commercial scale. As yet but a small percentage of the trees grown are of an age to produce fruit; it is considered, however, that in a few years a considerable supply should become available. It is estimated that an area of 100,000 acres would be required to supply the present American demand. The quality of the American oil is said to be better than the Chinese and freer from impurities.

Turning now to the activities in this direction in the British Empire, it is apparent that they fall far short of the American. Prior to 1927 they were almost negligible. It has been stated that experiments were started in various Colonies in 1917, though the amount of available seed was small. Kenya had a record planting at 5500 feet in 1922, seed from the trees being sent to the Imperial Institute in 1927. India carried out experiments at the Forest Research Institute at Dehra Dun. In 1924 trees of *A. Fordii* were fruiting at six years old but the seed germinated badly. The work, however, was still in an experimental stage.

The last two years have witnessed a real movement. It was in 1927 that the Research Association of British Paint, Colour, and Varnish Manufacturers took the matter up and Dr. Jordan's first pamphlet appeared, of which 600 copies were printed and widely distributed; considerable interest and enthusiasm on the subject was thereby stimulated in many parts of the Empire. The Research Association then took the step of purchasing 700 lb. of selected seed of *A. Fordii* of the 1927 American crop and distributed it to privately owned farms and estates, government agricultural stations, and forest officers over the widest possible area. The general manager of the American Tung Oil Corporation rendered invaluable help in this matter, not only with seed but also with advice; "for the American view", says Dr. Jordan, "is that beyond a certain point they must ultimately look to British Empire production to augment their own supplies". The distribution of the seed by the Research Association was effected with the help and advice of Sir William Furse, Director of the Imperial Institute, and Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew, who heartily co-operated.

The seed was sent to middle and East and South Africa, India (Nilgiris, Malwa plateau, C.I., Bihar and Orissa, Bengal and Assam, the latter province being regarded as the most promising), Malaya, Ceylon, and Burma, where *A. montana* is indigenous. Seven tea estates have taken up the matter in Assam. All of them report approximately 50 per cent germination. One estate reports trees averaging 4 ft. in four months after transplanting: three reported 6 ft. trees as the rate of growth from seed in one season.

Cyprus is experimenting with the seed, and work is being carried out in the West Indies, Palestine, Australia, and New Zealand. Reports as to progress are insisted upon from all recipients of seed; as Dr. Jordan tersely puts it, "No reports—no seed". So far the reports received are mostly favourable. It is impossible to follow Dr. Jordan further in his most valuable and interesting paper, which deals fully with culture, extraction, exports, and so forth. To show the extent of the progress achieved the following extract may be quoted: "As far as Africa is concerned, tung oil plants of our 1927 seed are now being watched everywhere from Kenya to the Cape—in Nyasaland, Tanganyika, the Rhodesias, Transvaal, Natal, and Cape Province, and in Nigeria". The Research Association of British Paint, Colour and Varnish Manufacturers and Dr. Jordan are to be congratulated on initiating a most valuable piece of work which appears likely to introduce a new Empire industry.

News and Views.

SIR DONALD MACALISTER, president of the General Medical Council, who has been Principal and Vice-Chancellor of the University of Glasgow since 1907, has submitted his resignation, which will take effect early in October, after the opening of the War Memorial Chapel. His successor, who is appointed by the Crown, will be available for the early part of the winter session. There is little doubt that when the General Council of the University proceeds to the election of a Chancellor in succession to the late Lord Rosebery, it will take advantage of the opportunity of retaining Sir Donald's services. The office has been generally held by a Scottish peer. Sir Donald's resignation brings to an end a principalship, the success of which is probably unprecedented in the annals of Scottish universities. During the past twenty-one years, the University of Glasgow has made remarkable progress, due mainly to the Principal's genius in administration. He soon introduced great improvements in the business of the University and has unquestionably made it a far more efficient and competent organisation. Before he took office, there had been frequent friction between the University Court and Senate; but his capacity as chairman of the Court and the full confidence of the teaching staff in his judgment, insight, and statesmanship have allowed the Court without opposition steadily to increase its control of the University. This change was inevitable, as the Court has remained a body of fourteen, of which the Rector's membership is nominal, while the Senate has increased in number from 33 in 1907 to 62.

THE number of professors in the University of Glasgow has grown during Sir Donald MacAlister's term of office from 33 to 50, an increase of more than 50 per cent, while the number of lecturers has been raised from 32 to 135. The increase in the teaching staff has been partly due to the confidence inspired in the University among the citizens of Glasgow, who have generously endowed new chairs and lectureships, while Sir Donald has recognised that in modern conditions university departments can no longer be run by one man, but are dependent on a group of teachers. The number of students has increased from about 2500 in 1906–7 to 4761 in the session 1927–28, so that the University of Glasgow is now the largest in Scotland, and in Britain is exceeded only by London and Cambridge. Sir Donald initiated a Students' Welfare Fund which has provided a new Students' Union, increased facilities for recreation, and a large pavilion on the sports ground. The University buildings have been extended, including a well-equipped Department of Zoology, and new lecture and class rooms for arts have been provided by completion of the west quadrangle in the main University building. Sir Donald MacAlister has also arranged for great improvements in the University Library and in the Hunterian Museum, for which he secured an income that has rendered possible its development on lines worthy of the University. The trust in Sir Donald MacAlister felt by the business men of Glasgow was shown at the dinner given him last winter in honour of the twenty-first year of his brilliant principalship.

SIR HENRY A. MIERS continues his campaign on behalf of museums. His Carnegie Report in reality dealt with the whole theme, but he has, since its publication, elaborated the educational possibilities of museums in an address to the Royal Society of Arts. Now he turns to the museum people themselves, and in his presidential address to the Museums Association, delivered on July 2, at the annual conference of the Association at Worthing, he indicates the directions in which they may help themselves, or better still may help each other. The title of the address indicates its theme—"Co-operation: The Task of the Museums Association" (*Museums Journal*, August). Sir Henry doubts whether a unified national museum service organised under one of the great Departments of State could be successful in Great Britain. The county organisation which he suggested as the basis for a thoroughgoing reformation, referred to in a leading article in NATURE of July 14, 1928, is ideal in many ways, but it is limited in scope, and if a move is to be made towards a wider national co-operation, local efforts must be reinforced by a more general scheme. The driving force of such a scheme ought to centre in the Museums Association, which already contains a nucleus, not too large but representative, of museum workers, and has at hand the machinery for organised effort.

THE weight of the Museums Association's authority must be directed to a determined effort at co-operation aimed particularly at uplifting the less efficient museums, and so raising the whole existing museum service to a higher level. But this requires a certain amount of reorganisation within the Association itself. It must appoint a Council, which would meet as often as need be, to formulate and carry out an active policy. The annual meeting must be taken seriously and must be supplemented by sectional meetings in different centres, by organised visits to local museums, by discussions of particular difficulties as well as of the more general museum themes. More use should be made of the *Museums Journal* in making known individual wants and in pooling experience. Museum publicity should be encouraged and organised, and joint efforts made to arrange special exhibitions with the view of attracting and educating the public. Finally, some attempt should be made at training youth for museum work, first in a simple way by holding a summer school for instruction, at which diplomas of efficiency would be granted, and this might ultimately develop into a school of curatorship, as has happened in the case of the librarians. These suggestions are the bare bones of a progressive policy. They imply much forethought as well as spade work, but they would help on the museum movement and at the same time would add to the efficiency and the authority of the Museums Association itself.

Last February we directed attention to the initial steps being taken to commemorate in a worthy manner the centenary of Faraday's discovery on Aug. 29, 1831, of electromagnetic induction. From those initial steps came the formation of two committees: the first, consisting of representatives of the Royal Society, the British Association, the Royal Institution, and other bodies, is concerned with the purely scientific aspects of Faraday's work in relation to the proposed celebrations; while the second, consisting of representatives of the principal organisations of those industries which have arisen from Faraday's discoveries, is dealing with the industrial aspects of the celebrations. This second committee has been called together by the Institutio nof Civil Engineers. The dates of the celebrations have now been fixed, and the proceedings will commence in London on Sept. 21, 1931. The British Association centenary meeting will begin in London on Sept. 23. These two centenaries, with important electrical conferences and other events which are to take place at the same time, will conjoin to make 1931 a memorable one in every country where the genius of Faraday has borne fruit.

The results obtained by the British Association's expedition to excavate the ruins at Great Zimbabwe, of which Miss Caton-Thompson was in charge, were of course reported at the recent meeting of the Association, and a cabled account has appeared in the *Times* of Aug. 3. Excavation was not confined to Great Zimbabwe but was extended to Dhlo-Dhlo and other sites. The results must therefore carry greater weight than if the work had been confined to one site alone. It is evident that the investigations have been carried out on rigidly scientific lines and most careful records made so that the results should be beyond cavil. In a number of cases digging was carried down to bed-rock. Native pottery and weapons and medieval imported objects were found at the lowest levels. On this evidence and that of the walled structures themselves, Miss Caton-Thompson finds herself in entire agreement with the conclusions of Dr. Randall-MacIver.

No object found at Zimbabwe could be dated before about A.D. 600 and the buildings were probably much later. Miss Caton-Thompson thinks the Zimbabwe culture to be "a vigorous native civilization, unsuspected by all but a few students, showing a national organisation of a high kind of originality and amazing industry". Since Dr. Randall-MacIver presented his report on the Zimbabwe ruins to the British Association on the occasion of its former visit to South Africa in 1905, his conclusions have been violently attacked, his methods severely criticised, and his freedom from bias openly questioned. During the last twenty-five years a vast experience has been gained in many fields in the application of archæological methods. Yet in 1929 Miss Caton-Thompson is able to agree with Dr. Randall-MacIver's conclusions in 1905. No more complete and satisfactory vindication of the methods and results of the earlier investigation could be desired. Until some new and utterly divergent evidence appear, the Zimbabwe question may be regarded as settled.

The rapid increase in the number of overhead lines in Great Britain makes the question of the best method of supporting them a very important one. In a paper on concrete poles by W. T. Taylor, published in the *Electrician* for July 26 and Aug. 9, a very strong case is made out for the use of concrete poles. Everyone who has travelled through western Europe recently must have noticed the large number of high-tension lines which are being built and are supported by concrete poles. In Great Britain the atmospheric conditions lead to the rapid rusting of lattice steel masts. This rapid depreciation has to be added on to the initial cost when discussing the relative merits of steel and wood pole lines. Mr. Taylor proves that this fact in many cases turns the scale in favour of wood poles. In the Shannon scheme the Dublin high-tension line (110 kilovolts) is supported entirely by lattice steel masts, the 38 kv. lines are built on steel poles in the southern and wood poles in the northern areas, and for the 10 kv. lines wooden poles are used exclusively. One great advantage of reinforced concrete poles is that they maintain their initial strength apparently indefinitely. Painting and renewing or resetting poles are entirely eliminated by concrete construction. They are no trouble to landlords or tenants, and hence wayleave costs are reduced to a minimum. Steel poles are about 30 per cent dearer than wood poles, but concrete poles are only about 10 per cent dearer. The great saving, however, in upkeep costs makes the reinforced concrete pole much more desirable from the economic point of view than either steel or wood poles of any type. In appearance however, they are heavy and clumsy and are not so neat and trim as steel or wood poles.

Prof. E. W. Marchant read an interesting paper at Johannesburg on Aug. 1 before Section G of the British Association on the limits of economical transmission of electrical power. He pointed out that there is now no special technical difficulty in transmitting electrical energy over several hundreds of miles. It would therefore be useful to compare the cost of generating electricity at a power station near a coal-pit and transmitting it to a town, with that of transporting the coal by rail to a generating station in the town itself. To make the problem definite, he considered the relative merits of a power station at Wigan, where there are many excellent coal-pits, with one in Liverpool, twenty miles away, the coal in the latter case being conveyed by rail. With ordinary everyday efficiencies for the power station, the electrical scheme is the more economical. If, however, an electric unit could be generated for one pound of coal consumed, an efficiency towards which large power stations are now approaching, there would be equality of costs between the two methods. At still higher efficiencies it would be more economical to transport the coal, since, for a given output, transport costs diminish as the efficiency increases, whilst electrical transmission costs remain constant. In his comparisons Prof. Marchant adopts the standard English pressure of 132,000 volts. Electricians have already made experiments on an overhead line designed for a million volts and no

unforeseen difficulties have arisen. The line with its lofty steel lattice towers, however, looks more like a bridge than a transmission line. Prof. Marchant also compares the cost of supplying hydroelectric power from the Victoria Falls to the Rand, a distance of 600 miles, with that of steam generation in the Rand itself. He concludes that if the cost of fuel in South Africa increases, the exploitation of the Victoria Falls will be economically feasible.

IN a short article in the July *Scientific Monthly*, Tze Tuan Chen directs attention to the fact that "some ideas of the origin of species, of variation, of adaptation, and of the structure-function theory were formulated [by Chinese thinkers] several thousand years before Darwinism came into existence and have all been neglected by Western writers in their history of the theory of organic evolution". He cites examples of evolutionary sorts of notions which occur in Chinese folk-lore and myths, such as the still existing superstition that a shark will change into a tiger when it gets on land; but to our minds such magical tales have no bearing upon the scientific thesis that one animal is evolved from another. There is more to be said for the philosophy of Confucius, who in the sixth century B.C., in his "Yi-ching", expressed the idea that things were originated from a single simple source through "gradual unfolding and branching", or in the self-transformation theory of Chuan-tze (fourth century B.C.). In one place that writer stated that "the life of all living things is like the running of a horse, changing and moving at every moment. What do living things do? They will naturally transform themselves." And again, "All living things are species developing to various forms through the process of variation". These are suggestive words, much more indicative of a pregnant speculation than other examples the author quotes.

WE have received from Messrs. Adam Hilger, Ltd., a copy of a bulletin issued by their Sales and Research Department, giving particulars of the work of the firm during the thirty months ending Dec. 31, 1928. It is a notable record in many ways, but it is particularly satisfactory to read that their activities can now be limited to the manufacture of instruments for research. It is noteworthy, too, that more than one-half of the sales in 1928 were to foreign countries, several especially large purchases of spectrometers and interferometers having been made by German laboratories, including the Physikalische Technische Reichsanstalt at Charlottenburg. Some of the new instruments mentioned in the bulletin have already been referred to in NATURE. A very useful feature is the inclusion of a list of some two hundred and fifty references to Hilger instruments in scientific journals; it is often difficult to decide the exact form of instrument best suited for a research, and a list of this type is an invaluable addition to Messrs. Hilger's well-known general catalogue.

AN interesting development in the activities of the Faraday Society is the exchange of certain reciprocal privileges with the American Electrochemical Society and with the Deutsche Bunsen-Gesellschaft. Under the new arrangement, members of the Faraday Society can become full members of the other societies on payment of reduced subscriptions, and vice versa. Membership includes the receipt of all publications issued by the societies to their ordinary members. There can be no question that this arrangement will not only improve the position of the societies participating, but will also be a substantial step towards international co-operation in science.

LORD LEE of Fareham has accepted the chairmanship of the Radium Commission which has been set up to undertake the custody and distribution in Great Britain of radium purchased by the National Radium Trust.

IN a letter to the editor, Mr. Maynard Shipley states that the 'shaky composition' attributed to him (NATURE, May 11, p. 735) was due to the printer, and that his statement regarding the prevalence of a belief in witchcraft in 'vast districts' of Scotland was derived from two natives of that country. It is clear that, at any rate, one of these witnesses was referring to the days of his childhood in Scotland, but rural Scotland has changed much in the intervening years.

IN NATURE of Aug. 3, p. 208, it is stated that the epicentre of the earthquake recorded at Kew Observatory on July 23 was close to the north coast of Ireland; this should be Iceland. Dr. F. J. W. Whipple informs us that the shock in question was felt at Reykjavik. According to a bulletin issued by the International Seismological Bureau at Strasbourg, the probable position of the epicentre was 64° N., 23° W. This is very close to the south-west coast of Iceland.

BY an Order of the Committee of Privy Council, the Viscount D'Abernon and Major A. G. Church, M.P., have been appointed members of the Medical Research Council on the retirement of the Earl of Balfour and of Sir Charles Trevelyan, Bart., M.P. Lord D'Abernon will succeed Lord Balfour as chairman of the Council. By another Order, made after consultation with the Medical Research Council and with the president of the Royal Society, Prof. J. J. R. MacLeod, Regius professor of physiology in the University of Aberdeen, and Mr. Wilfred Trotter, honorary surgeon to H.M. the King and surgeon to University College Hospital, London, have been appointed members of the Council in succession to Prof. E. P. Cathcart and Sir Charles Sherrington, who retire in rotation on Sept. 30.

IN connexion with Prof. Boys's letter in NATURE of June 29, p. 981, on electrified omnibuses, Mr. Charles Macnamara, Arnprior, Ontario, Canada, informs us that in Canada motor tank-trucks for distributing motor spirit to service stations are commonly 'earthed' by a short piece of iron chain which drags on the road beneath the truck. This avoids the risk of a spark, which might, in the circumstances, be dangerous. Mr. Winn W. Davidson, of Gilroy, California, in a letter to the Editor, also refers to this practice, adding that "in the hot interior valley of the San

Joaquin, where during the summer the mean monthly temperatures often range from 100° to 114° F., with an average humidity of 33 per cent, it is customary for the service station attendant to touch the metal-work of automobiles with the metal nozzle of the hose leading from the gasoline pump, before he proceeds to fill their gasoline tanks. If this is not done, there is danger that a spark in the narrow opening of the gasoline tank might ignite an explosive mixture of gasoline vapour and air."

THE eighth Conference Bibliographique Internationale will be held, by kind permission of the governors and Prof. H. L. Callendar, in the Imperial College of Science, South Kensington, on Sept. 16 and 17. The first day will be occupied with council meetings. The general assembly and conference, to which visitors are invited, will commence at 10 A.M. on the second day, when Prof. A. F. C. Pollard will give the presidential address. The agenda includes further proposals for the reorganisation of the Institut International de Bibliographie of Brussels, reports of the commissions on Cataloguing Rules and on Documentary Technique, and a discussion on the possible unification of the aims and objects of international bibliographical organisations. In view of the fundamental importance of information services to science and technology, it is hoped that all who have at heart the organisation of information will endeavour to be present and assist in the discussion. The subscription to the Conference is ten shillings. Further information may be obtained from the organising secretary, Mr. H. T. Pledge, The Science Library, London, S.W.7.

THE Ministry of Health has issued a "Report on Rural Water Supplies" (London: H.M. Stationery Office, price 9*d*. net). It deals with both 'piped' and 'non-piped' supplies, concerning which many practical and financial details are supplied. It is considered that where a piped supply is unobtainable, there is no reason why rain water should not be utilised, at least in country districts, particularly for small dwellings.

WE have received the Annual Report for 1928 of the Department of Pathology and Bacteriology of the University of Leeds, by Drs. Stewart and McLeod, the professors of pathology and of bacteriology respectively. A brief summary is given of the work of the Department and a list of papers published by members of the staff. In an abstract report on cancer research by Prof. Passey, reference is made to work by Dr. Berenblum which shows that mustard gas is capable of inhibiting the production of experimental cancer in mice by an active cancer-producing tar, even if first applied eleven weeks after the commencement of the tar treatment.

THE April-June issue of the *World's Health* (vol. 10, No. 2) commemorates the tenth anniversary of the foundation of the League of Red Cross Societies. Among the articles, one by Dr. Pierre Béhague describes the organisation of first aid on French roads. First-aid posts are created wherever the road is dangerous outside towns and villages, twenty posts on an average being provided for every hundred kilometres of road, and there are at present nearly a thousand of these posts. First-aid material is kept at the posts, and a staff, including doctor, is attached to each one.

THE review of the work of the Rockefeller Foundation during 1928 has been issued by the president, Mr. George E. Vincent. No less a sum than 21,690,738 dollars was disbursed. Among the objects to which sums were contributed may be mentioned (*a*) lands, buildings, or endowments for eighteen medical schools in fourteen countries; (*b*) support of the Peking Union Medical College; (*c*) aid to Brazil in combating a new outbreak of yellow fever and continued studies of that disease in West Africa; (*d*) aid to the governments of twenty-one countries in fighting hookworm disease; and (*e*) grants to health services, for fellowships, and to the Health Organisation of the League of Nations, and several other activities bearing on hygiene and health. An interesting review of the work of the Foundation during the past sixteen years is also included.

GEOGRAPHERS and librarians should be interested in the latest catalogue of Mr. W. A. Robinson, 4 Nelson Street, Newcastle-upon-Tyne, which deals with upwards of 300 second-hand works on early American voyages and other travels.

WE have received a "Catalogue of Cine Cameras and Projectors" from Messrs. Sands, Hunter and Co., Ltd., of 37 Bedford Street, Strand, W.C.2. It will be convenient to those who are interested in such apparatus and their accessories to have so many of the various patterns that are on the market included in a single list.

THE McGraw-Hill Publishing Co., Ltd., 6 Bouverie Street, E.C.4, has just issued new editions of its special sectional lists Nos. 2 and 13 relating respectively to books on radio engineering, telegraphy and telephony, and astronomy, mathematics, meteorology, and physics. Copies can be had free upon application.

WE have received from the publishers, Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street and 24 Gower Place, W.C.1, the new edition of the Catalogue of Lewis's Medical and Scientific Circulating Library, revised to the end of 1927. The catalogue is in two parts: Part 1, authors and titles, and Part 2, classified index of subjects. Part 1, which runs to more than 400 pages, contains the full titles of the works listed, under authors' names. The classified index of subjects in Part 2 should be very useful apart from the library. In it under a subject the names of authors of works are given, with date of publication, so that the later works may be picked out if desired, and by reference to Part 1 the full title of the book can be found. Subjects are, moreover, subdivided; for example, 'Botany' has eight subdivisions—alpine, economic, geographical, etc. The library contains a considerable selection of works in medicine and general science, and the subscription terms appear to be very reasonable and free from restrictions.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant veterinary inspector under the Surrey County Council—to carry out duties under the several Acts and Orders relating to : Milk and Dairies ; Diseases of Animals ; and such other veterinary duties as the Council may require—The Clerk of the County Council, County Hall, Kingston-upon-Thames (Aug. 19). An assistant lecturer in the Chemistry Department of the Derby Technical College—The Secretary, Education Committee, Becket Street, Derby (Aug. 28). A chief inspector of weights and measures under the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Aug. 31). A male lecturer in education at University College, Southampton—The Registrar, University College, Southampton (Sept. 2). Probationary assistant engineers in the Engineering Department of the Post Office—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Sept. 12). Lecturers in mechanical engineering and in civil engineering, at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 14). An assistant lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (Sept. 16). A professor of physiology at the Presidency College, Calcutta—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Oct. 31). A lecturer in physics at the Memorial University College, St. John's, Newfoundland—S. J. Harrington, Woodfield, Malvern Wells. A full-time lecturer in mechanical engineering at the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A marketing research assistant at the National Institute of Poultry Husbandry—The Director, National Institute of Poultry Husbandry, Newport, Salop.

Our Astronomical Column.

Telescopic Bielid Meteors.—Prof. Charles P. Olivier, who is the director of meteoric observations in the United States, notes in *Astr. Nach.* 5641, that Mr. Franklin W. Smith, while guiding for a photograph in Andromeda on Nov. 11, 1928, saw 11 telescopic meteors pass through the field (which was 1° in diameter) in the period of 102 minutes. He noted the position angles of the meteors, from which Prof. Olivier deduced that 10 out of the 11 were members of the Bielid stream, otherwise known as the Andromedids. The radiant was found to be R.A. 10°, Decl. + 40°, with an error not exceeding 3°. There were several conspicuous Bielid showers in the last century, and the present observation is of value as helping to trace the present position of the stream. Prof. Olivier expresses the hope that any observers who may see telescopic meteors will make a record of the time of observation, and the position and direction of the tracks.

Curve of Solar Activity from 1877 to 1928.—Signor Luigi Taffara, of Catania Astrophysical Observatory, has published a discussion of the solar activity during the above period in *Mem. Soc. Astron. Ital.*, vol. 4. Spots and prominences are separately discussed, and a curve drawn from a combination of all forms of activity. The dates of maximum are given as 1884·78, 1893·50, 1905·62, 1917·31, 1928·50. Those of minimum as 1878·89, 1889·76, 1902·11, 1913·38, 1923·50. The highest maximum is that of 1893, and the curve indicates some tendency for successive maxima to be alternately high and low ; this would harmonise with the conclusion that the complete cycle comprises two eleven-year periods, which was deduced from the alteration of the law of polarity of spots in successive eleven-year cycles. The author gives 4·313 years as the mean interval from minimum to maximum, and 6·728 years for that from maximum to minimum.

Prof. Aitken's Double Stars.—*Lick Observatory Bulletin*, No. 413, contains remeasures by Prof. Aitken of 296 of the double stars discovered by him early in the century. Several of the stars give evidence of motion ; in a few cases, this is sufficient to enable approximate orbits to be calculated, and in many more cases it is sufficient to deduce dynamical parallaxes. These deductions have not been made as yet, but the list offers material for those who have leisure for the research. More than one-third of the stars are of spectral type $F5$ to $G2$ and the remainder are divided nearly equally into the groups $B8$ to $A3$, $A5$ to $E2$, $G5$ to $K2$. Aitken 111 is an interesting triple star. The close pair consists of two equal stars, magnitudes 9·1, mean distance 0·18″, period 10·5 years. The third star, the connexion of which is proved by common proper motion, is distant 2·2″ ; its magnitude is 12·5. Aitken 1928 has also a short period, about 19 years. An orbit, computed in 1918, is given for the naked-eye star 83 Aquarii ; period 23·82 years, a 0·245″. The list closes with measures of 14 new double stars discovered in the last two years.

Stark Effect in Stellar Spectra.—It has been considered for some time past that the great widths of hydrogen lines in stellar spectra are due at least in part to the Stark effect. A discussion of line widths in early-type stars by Dr. O. Struve (*Astrophysical Journal*, **69**, 173) shows that the broadening in these types is probably due to a combination of Stark effect, axial rotation, and abundance. The general appearance of the lines agrees with the requirements of the theory, and the asymmetrical broadening of the lines which would be expected from the fluctuating Stark effect is also in good agreement with observation. The Balmer lines, if broadened by the Stark effect, should increase in width from $H\beta$ to $H\epsilon$, and although measures by Elvey show such an increase, the amount observed is smaller than the expected value (a discrepancy which is also found in laboratory experiments). Dr. Struve finds a definite theoretical relation between line width and absolute magnitude in which stars with narrow lines are more luminous than those with broad lines. This agrees well with the well-known luminosity effect discovered by Adams and Joy, which is used at Mount Wilson and at the Norman Lockyer Observatory in the determination of spectroscopic parallaxes of early-type stars.

Research Items.

Prehistoric Man in East Africa.—In *Man* for July Mr. E. J. Wayland discusses the dating of prehistoric man in East Africa in connexion with the geological evidence from pluvial periods in that area in the quaternary age. He suggests that archæologists, in drawing conclusions from this evidence, have not observed all due caution which the conditions demand. It is now possible to tabulate the major events in the Pleistocene history of this country. There are three moderately well-fixed points: First, Oligocene earth movements which superinduced the present topography on an older; second, a mid-Pleistocene dry period; and then a moist period preceding the present. By means of correlation of the evidence at different points, it appears that, at the time of the laying down of the gravels of what is called the 175 ft. terrace, that is, early (perhaps including *late*) Pleistocene times, there was a climatic change, possibly a local expression of a world event, at a time when the Günz-Mindel pluvial should have occurred. For these reasons the First Pluvial is tentatively accepted. There is abundant evidence of a similar change after the mid-Pleistocene dry spell, which is regarded as the second Pluvial. It was followed first by a brief period of aridity and then by the sub-recent moist period, scarcely to be called a pluvial. It is argued that this last period corresponds to the Bühl with Magosian (epi-palæolithic) industry; the second Pluvial to Riss-Würm with Sangoan (Mousterian with local facies) industry, and the First Pluvial to Günz-Mindel with Kafuan (pre-Chellean) industry. It is noted that no unquestionable Chellean, Acheulean, and Neolithic remains have yet been found in Uganda. On this dating the Third Pluvial of the Kenya Archæological Expedition becomes the equivalent of Epi-Pluvial and Nakuru man no older than the Fayum Neolithic.

Unitary Behaviour of the Nervous System.—In his presidential address to Section 3 of the Royal Society of Canada, delivered at the meeting in May last, Prof. Frank Allen, professor of physics in the University of Manitoba, made an interesting contribution to the study of neural phenomena. Investigations extending over a period of twelve years and involving ingenious methods for correlating the degree of sensation with the insensity of stimulation, have culminated in a broad generalisation which, in effect, permits the application of an equation of Fechner's form, not only to the subjective phenomena of sensation, but also to all types of physiological responses and to so-called psychological processes. In order to embrace responses (S) given by very strong and very weak, as well as the usually accepted medium intensities (I) of stimulation, Allen shows that his graphs conform to the generalisation

$$S = \pm k \log I + c,$$

where k and c are constants possessing physiological significance and the + or − signs are to be interpreted according as to whether the effect of a stimulus is to enhance or to inhibit the response of a succeeding stimulus. The application of this equation to certain phenomena of colour vision, taste, etc., and even learning processes, tends to remove many of the difficulties associated with these.

American Shore Birds.—In a second part of his account of the North American 'waders', Arthur Cleveland Bent describes the habits—courting, nesting, and breeding—of forty-five species, some of which are even more distinctively European than American (*U.S. Nat. Mus. Bull.*, 146). The accounts are thorough, as may be judged from the size of the volume, 340 pages, and they bear evidence of careful record-sifting. Amongst much of interest to the ornithologist and naturalist in these pages, we cite only the recent discoveries, after many years, of the nest and eggs of the surf bird (*Aphriza virgata*) 1000 feet above the timber-line in Alaska, of the wandering tattler (*Heteroscelus incanus*), also in Alaska, and the account of the practical extermination of the Eskimo curlew (*Numenius borealis*), which is attributed to the slaughter of migrating birds in Canada and the United States.

Deep-water Sponges.—M. Burton (*Jour. Quekett Microscopical Club*, vol. 16, 1928) has given an interesting comparative account of the characteristics of shallow-water and deep-sea sponges, with notes on their external form and reproduction. While light is perhaps not essential to growth, there is a suspicion that in some species it contributes materially to the well-being of the sponge, and that it may constitute an important factor in determining the depths to which the species can penetrate. Discussing the skeleton, the author is led to conclude that it is impossible for sponges to exist without skeletal support for the tissues except in the very shallowest waters, and that in default of its proper skeleton the sponge will use almost any means (for example, by packing its tissues with sand grains, etc.) to make good the deficiency. It is known that the formation of spongin can usually only take place in moderate temperatures and the restriction of the Euceratosa—with few exceptions—to the seas between 45° N. Lat. and 45° S. Lat. supports this view, as also does their abundance in the warm shallow waters of the Mediterranean and the Gulf of Mexico. Deep-sea sponges are characterised by the symmetry and regularity of their external form, lack of colour, adoption of special methods of reproduction and the development of structures—long stalks of spicules, or basal tufts of spicules which, becoming matted with mud, act as floats or rafts—which lift the animals above the unstable substratum of oozes. The author discusses each of these characteristics. He states that in the deep-sea Tetraxonida, particularly those living below 600 fm., ova and sperms and the early stages of cleavage are unknown, but many hundreds of embryos have been found. The fact that these are all in an advanced stage of development and the absence of ova leads the author to doubt the sexual origin of the embryos.

Hydatids in South Australia.—In a further paper on this subject (*Bull.* No. 40; Council for Sci. and Ind. Res., Australia, 1929), Dr. I. Clunies Ross finds considerable variation in the size and shape of the hooks in the species *Echinococcus granulosus*. The eggs are viable under moist conditions in summer for three weeks, but they will not withstand desiccation. Hatching of the egg appears to occur normally in the small intestine. Hydatid cysts remain viable after removal from the host for four days at 20°-23° C., and for thirteen days at temperatures between 4° and 8° C. Adult *Echinococcus* require about seven weeks for complete development. The most important control measure to prevent infection of the dog is the boiling of all offal of cattle, sheep, and pig before feeding to dogs. Infestation of man with the cysts, which appears to be increasing in South Australia, is preventable by the observance of elementary rules of hygiene, such as washing after handling any country dogs. Dogs

should be treated periodically to free them from the adult worm (arecoline hydrobromide is highly efficacious for this purpose). The author emphasises the importance of an educational campaign for the instruction of stockowners and others as to the nature of hydatid disease and how it may be avoided.

Structure of Cellulose.—Because of its industrial and botanical importance, the structure of cellulose continues to arouse considerable interest. A recent number of the *Journal of the Textile Institute* (**20**, No. 6; 1929) contains two papers dealing with the interpretation of the structure from data derived from water absorption. A. Urquhart (pp. T 125-132) considers particularly the cause of the hysteresis during water absorption and desorption, while F. T. Pierce (pp. T 133-150) develops a mathematical treatment of a two-phase theory of the absorption of water vapour. In both cases, hydration and dehydration are treated as in part due to chemical forces at the surfaces of the cellulose units and in part due to the spaces between the micellæ.

Kimberlite Pipes and Sub-crustal Rocks.—The *South African Journal of Science* for December last contains a valuable article by Dr. P. A. Wagner on "The Evidence of the Kimberlite Pipes on the Constitution of the Outer Part of the Earth". Reasons are given for believing that the kimberlite magma originated at a depth of the order of 60 km. In addition to granite and gneiss, the xenoliths brought up by the magma include gabbro, amphibolites, pyroxene-granulite, eclogites of both types, and a great variety of peridotites. There is complete absence of any xenoliths that could be referred to the hypothetical basaltic substratum postulated by Daly, Joly, and Jeffreys. The sial crust is here apparently underlain by a shell of gabbroid amphibolites and granulites passing down into gabbroid eclogite. This in turn, if the reasoning is correct, is underlain by a great peridotite zone in which there are bands and lenses of pyroxenite and eclogite, both of types allied to peridotite. The chemical composition and radioactivity of the kimberlite eclogites do not support the hypothesis of the equivalence of eclogites and plateau-basalt. The amphibolite-granulite shell is tentatively regarded as a vast potential reservoir of basaltic magma. If Dr. Wagner's researches could be correlated with 'near' earthquake observations in South Africa, a definite advance in our knowledge of sub-crustal rocks would be achieved.

Eutectics and Igneous Rocks.—In a paper appearing in the *Comptes rendus de la Société géologique de Finlande*, No. 2, 1929, Prof. W. Wahl gives a valuable account of the theory of eutectics and its application to problems of the crystallisation of igneous rocks. It is shown that the influence of 'eutectic surfaces' on the behaviour of rock magmas during crystallisation provides a valuable clue to an understanding of the way in which individual members of the great rock families come to vary from one occurrence to another, and to contain minerals of varying composition within the limits of a few isomorphous series. The mixed crystals separating on different sides of a singular point on a eutectic surface are of different composition, and as crystallisation proceeds, they come to be enriched in opposite ways. Thus in magmas that differ in composition but slightly, crystallisation-differentiation may proceed in quite different ways. Change of pressure may affect the position of maximum and minimum points on the liquidus curve of a mixed crystal series, and therefore crystallisation-differentiation occurring at different pressures may result in the production of different residual magmas from the same parent magma. The paper shows how complicated the interplay of controlling circumstances may be, and is worthy of careful study by all petrologists.

Magnetic Survey of Italian Somaliland.—Volume 2 of Memoirs of the Central Office for Meteorology and Geophysics, Rome, contains an account by Prof. Luigi Palazzo of the magnetic survey of Jubaland and Italian Somaliland carried out in 1926. The principal instruments used were a Dover-Schneider magnetometer and a Dover dip circle. The positions of the points of observation were determined from government maps available, or in cases of doubt by direct measurements of latitude and longitude. The results are shown by lines of equal deviation, equal dip, and equal horizontal force over an area from Lat. 2° S. to 5° N. and from Long. 41°-46° E. The lines of equal deviation run approximately from north-west to south-east perpendicular to the Benadir coast, the deviation being 2° 10′ W. in the south at Port Sherwood and 0° 30′ W. near where the Shebeli River crosses the Abyssinian frontier. The lines of equal dip run from west-by-north to east-by-south, the dip being 11° south in the north and 25° south in the south. The lines of equal horizontal force run in nearly the same direction, the force being 0·34 in the north and 0·31 in the south. Corrections to the deviations of the compass recorded in the Italian and in the British Admiralty Charts exceeding in a few cases 1° are necessary.

Recombination of Electrons and Ions.—Prof. R. Seeliger has published a useful summary of the scattered papers dealing with the recombination of positive ions with free electrons, in the issue of the *Physikalische Zeitschrift* for June 1 (pp. 329 - 357). This particular atomic process is of importance in many connexions. It gives rise to a type of continuous spectrum stretching from the limits of a spectral series to shorter wave-lengths, and extension of recent laboratory work in which such spectra have been studied in conjunction with electrical measurements by Dr. Langmuir's methods should be of great value in elucidating the conditions under which similar spectra can be produced in stars. Some of the still incompletely understood phenomena of the Geissler discharge are also beginning to yield to the same treatment. On the theoretical side, recombination comes in as one of the unit processes occurring in the maintenance of equilibrium in thermally ionised media, and so again becomes important in connexion with the theory of stellar atmospheres, whilst very recently it has, like many other rather obscure phenomena, been receiving the attention of the quantum mechanics. Prof. Seeliger dismisses this last aspect of recombination in a few lines, but proposes to return to it again later. The value of critically written articles of this type at the present time cannot be too strongly emphasised.

Acoustics of Public Halls.—An article in the *Journal of the Franklin Institute* for July by Emile Berliner, whose death has recently been reported, gives an account of a method he invented for improving the acoustical properties of auditoria and public halls. About one quarter of the total area of the auditorium walls underneath the ceiling is covered with wire cloth diaphragms over which is spread a special porous cement mixture. When dried and hardened, this forms a smooth cement wall surface. Cement diaphragms thus formed are found to be as vibratory as the sounding boards of pianos. They diffuse as well as reflect the sounds which fall on them coming from singers, speakers, and mechani-

al sources. This has a marked tendency to prevent both reverberations and echoes. Practical experience has shown that this method has been successful in improving very appreciably the acoustic conditions. When theatres are treated in this way it is sometimes found possible to reduce considerably the size of the orchestra. Hitherto absorption has been mainly relied on to eliminate reverberations. The Berliner method is stated to give better results. These diaphragms cannot be used on floors. Furniture and audiences have to be depended on to prevent the disturbing sounds which would otherwise proceed from empty and reflecting floor spaces. An audience filling about a quarter of the floor space is usually effective in preventing the disturbances which would otherwise arise from the floor.

Ultra-Violet Microscopy.—The June issue of the *Journal of the Royal Microscopical Society* contains the presidential address delivered in January last by Mr. J. E. Barnard, on some aspects of ultra-violet microscopy. Mr. Barnard discusses the materials—quartz and fluorite—available for making lenses, slides, and cover-glasses for ultra-violet microscopy, and points out the results of the defects present in some samples of these substances which render them useless for this special purpose. He then passes to consider the illuminants suitable for ultra-violet work and states that the cadmium spark-image in wave-length 275 $\mu\mu$ is still the most suitable. He uses a pin-hole camera for observation of the spark-image so as to enable an image of almost constant length and form to be secured by adjustment of the spark-gap at short intervals. Turning to dark-ground illumination, he points out that a silvered surface, such as is used for visual light, is quite unsuitable for ultra-violet work, and that magnalium is the best metal hitherto found for this purpose, as in certain wave-lengths it reflects as much as 81 per cent of the incident light, but this is contingent on the production of a polished surface of high quality. Messrs. R. and J. Beck, Ltd., have produced an ultra-violet dark-ground illuminator, the reflecting surfaces of which are of magnalium, and the top lens, which is in immersion contact with the under side of the slide, is of fused quartz. Mr. Barnard expresses the opinion that the results achieved with this apparatus and a quartz objective mark a striking advance. In conclusion, he refers to the wealth of fine detail shown in the photographic negatives obtained and expresses the hope that the method may contribute to the advance in our knowledge of the filterable viruses.

Preparation of Phosphorus Trioxide.—Since the preparation of phosphorus trioxide in a state of purity by Thorpe and Tutton in 1890, several experimenters have had occasion to obtain this compound. In no case, however, have any details of this difficult preparation been published which would provide a possibility of obtaining any control over the yield of the trioxide. These have recently been given in full by Wolf and Schmager in the *Berichte* of the German Chemical Society and in the June issue of this journal Wolf, Kalaehne, and Schmager describe experiments on the other methods of preparation of phosphorus trioxide which have been reported, such as the action of phosphorus trichloride on phosphorous acid. It was shown that none of these methods gave any trioxide, and the authors state that the method used by Thorpe and Tutton, namely, the regulated combustion of white phosphorus in air, is so far the only one which leads to the formation of phosphorus trioxide.

Dichloramine.—Although the first and last chlorination products of ammonia, namely, monochloramine, NH_2Cl, and nitrogen trichloride, NCl_3, are known in the pure state, very little information is available as to the existence of dichloramine, $NHCl_2$. In the July number of the *Journal of the American Chemical Society*, R. M. Chapin describes some experiments in which a solution of ammonium acetate of definite acidity controlled by a buffer solution was treated with chlorine water similarly treated with a buffer solution. The resulting solution was extracted with ether or carbon tetrachloride and was also analysed for the nitrogen-chlorine ratio. The results showed that dichloramine is produced by the chlorination of ammonium ions at acidities in the range pH 4·4 to pH 8·5, being the sole product at pH 4·5 to pH 5·0. It is also produced by corresponding acidification of monochloramine solutions. So far, the substance is known only in solution.

Buildings to Withstand Hurricanes.—In an article in *Engineering* of Aug. 2, on "Recent Tornadoes and Hurricanes", Mr. R. Fleming summarises the reports on the damage done by the St. Louis tornado of Sept. 29, 1927, and the Porto Rico hurricane of Sept. 13, 1928, and refers to the lessons to be learnt in regard to the construction of buildings to withstand these severe storms. A committee of engineers and architects which reported on the St. Louis tornado, said that greatest damage was due to the effect of a partial vacuum at the centre of the tornado. While it might not be possible for any economical form of construction to withstand the maximum force of the wind, the indisputable teaching of the disaster was the importance of integral bonding between all parts of buildings, from the individual bricks of a wall to the completed structure. The velocity of the Porto Rico storm is estimated to have reached 180-200 miles per hour. At one place, Cayey, the effects were as destructive as elsewhere, but the 600 ft. wireless towers stood. Nuts were loosened, anchors yielded, bracing members bowed and snapped back to a taut position like cords, but no rivets were reported as being sheared or any members broken.

Fluid Flow in Pipes and Channels.—The flow of fluids in pipes and channels, which is of importance in such practical matters as the study of steam turbines, the design of boilers, condensers, and evaporators, the ventilation of buildings and mines, the handling of liquid fuels, questions of water supply, irrigation and sewage disposal, has been the subject of much experimental inquiry of recent years, by Reynolds, Stanton and Pannell, Schiller, Hopf, Fromm and others. In *Engineering* for July 19 and 26, and Aug. 2, Messrs. S. J. Davies and C. M. White give a review of the advances made in this branch of hydraulics. Beginning with notices of the work of Poiseuille in 1846, and of Darcy in 1857, they make especial reference to that of Reynolds, who first introduced streams of coloured liquids into the main stream of water passing through glass tubes and showed that at some critical velocity the motion changes from laminar or streamline to turbulent flow. He also applied dimensional reasoning to practical hydraulics, and thus laid the foundation of more recent research. In the experiments of the investigators mentioned, different liquids were used, the pipes and channels were made of various materials and of various cross sections, and to Fromm, working in conjunction with Hopf at Aix-la-Chapelle, we owe a comprehensive laboratory study of the influence of roughness. Recent advances owe much to the use of the principle of dimensional similarity, but that principle, though an almost universal tool of the scientific worker, has not yet received sufficient recognition by the practising engineer.

Toxicity Tests for Novarsenobenzene.

ALTHOUGH the arsenobenzenes of therapeutic value are, theoretically, chemical individuals, different batches of the same compound may vary both in toxicity and therapeutic efficiency, so that biological tests on each batch are essential before clinical use. Two separate tests are required, since toxicity and therapeutic efficiency are not proportional: in fact, they may vary inversely, and a toxic sample may have only a negligible therapeutic effect. The tests are usually carried out on mice. In the therapeutic test the animals are first infected with a trypanosome and the curative effect of a small dose of the drug under test observed; in the test for toxicity, larger doses are given and the mortality determined, the dosage being such that some proportion, but not all, of the animals injected die within some specified period after the administration. The toxicity tests in use for novarsenobenzene and neosalvarsan have been exhaustively examined by Durham, Gaddum, and Marchal: [1] their conclusions are of interest both from the point of view of toxicity tests in general, and also from the fact that they have led to the formulation of a simple and trustworthy test for this compound.

The test required is not one for the determination of the potency of the sample in terms of the standard, but one ensuring that its toxicity does not exceed that of the standard by more than a specified amount, and the investigation was directed to settling the limit of permissible toxicity and prescribing a simple test which would exclude the majority of samples exceeding this limit whilst passing the majority of those lying within it. The standard preparations were obtained from Prof. Kolle, of Frankfurt, who distributed them on behalf of the Health Organisation of the League of Nations.

The first aim was to obtain a curve relating death-rate to dose injected: this 'characteristic' curve has the S-shape common to toxicity curves in general. To eliminate possible variations in sensitiveness of different batches of mice injected on different days, the range of doses was given to animals of each batch each day, the experiment being continued for several days until a sufficient number of animals had been injected with each dose. Throughout the investigation, however, no evidence of a day or seasonal variation in sensitiveness was obtained. The curve is steeper, that is, small variations in dosage cause greater variations in mortality, when animals of a uniform stock are used, and especially when they are of much the same weight: greater accuracy is obtained with fewer animals of uniform sensitiveness than with a much larger number of a mixed stock. The curve was steepest with doses between 0·4 mgm. and 0·5 mgm. per gm. body weight, the mortality being observed over a period of three days after the injection. Investigation of the relationship between weight and sensitiveness showed that mice of 13-15 gm. weight are about 25 per cent more resistant than those of 18-20 gm. or 24-26 gm. Females of 18 gm. in weight or more are 8-10 per cent more susceptible than males, but there is little difference between the sexes in the case of the smaller animals: the males, however, are more uniform in their reaction. It appears from the results obtained that sex can be neglected, but that, if possible, animals of similar body weight should be used: if the limits of variation in weight are within 2 gm., the dose can be expressed in mgm. per mouse.

[1] Medical Research Council. Special Report Series, No. 128: Reports on Biological Standards. 2: Toxicity Tests for Novarsenobenzene (Neosalvarsan). By Florence M. Durham, J. H. Gaddum, and J. E. Marchal. Pp. 40. (London: H.M. Stationery Office, 1929.) 9d. net.

Having obtained the characteristic curve with the use of a large number of mice, it is possible to calculate the probability that not more than a certain number of a small number injected, for example, 5, 10, or 30 will die for different values of the true mortality, and hence the probability that the true toxicity of a given sample will be disclosed when only a small number of animals is used. In the specific case under investigation the upper limit of permissible toxicity has been fixed at 20 per cent above standard, so that the question to be settled is the probability of a sample within this limit passing and of one exceeding this limit being rejected, when the test is carried out with the use of only a small number of animals.

The tests at present in use have been examined with the aid of these calculations: the British is not sharply discriminative and allows an undue proportion of toxic samples to pass; the German gives a sharper discrimination but still passes many toxic samples; the Japanese and American are even less discriminative than the British, and fail to exclude many samples exceeding the limit of 20 per cent greater toxicity than standard.

As a result of the investigation an improvement in the test is proposed, to give greater discrimination and to exclude more of the toxic samples. The drug is dissolved in water, freshly redistilled with a condenser of hard glass, at 2 per cent strength, and the fresh solution injected into the tail vein of the animal. The mice used are fasted overnight, weighed, and then given food, the injection being made an hour or so later. The test is carried out in three stages. In the first, 10 animals, weighing 18-20 gm., are taken and into each is injected 7·6 mgm. of the novarsenobenzene: if not more than 2 die, that is, 20 per cent mortality, the sample is passed forthwith: among those passing would be samples with a toxicity less than that of the standard and about 61 per cent of those with a toxicity equal to that of the standard. The others are injected in the same dose into a further 10 mice, and the total mortality on the 20 animals so far used observed: if this is not more than 40 per cent, the sample passes: a further 38 per cent of the samples of standard toxicity should pass at this stage. Further, if more than 15 of the animals have been killed, the sample can be rejected without further test, as exceeding the limit of permissible toxicity. The remaining samples are injected into a further 10 animals: those which have killed not more than 15 of the total of 30 injected are passed, whilst those causing a higher death-rate are rejected. Hence the final demand of the test is for the survival of at least 50 per cent of 30 mice on a dose of 0·4 mgm. per gm. The test passes all samples of toxicity up to that of the standard, and fails 0·4 per cent of those of toxicity 10 per cent above that of standard, 59 per cent of those of toxicity 20 per cent above, and 99·6 per cent of those of toxicity 30 per cent above. If this test is considered to be too severe, 0·38 mgm. per gm. or a total dose of 7·2 mgm. can be used, when 94 per cent of samples of toxicity 20 per cent above that of standard would pass, but only 11 per cent of those of toxicity 30 per cent above.

The actual dosage used may require adjustment according to the sensitiveness of the stock of mice employed: the standard enables this sensitiveness to be tested from time to time and also allows of comparable results being obtained in different laboratories with different conditions of diet, temperature, etc. Samples of the drug properly dried and kept at low temperatures remain stable over several years, and show no increase in toxicity after this time.

An International Committee on the History of Sciences.

THERE was recently held in Paris the first meeting of the Comité International d'Histoire des Sciences, which owes its existence to the International Congress of Historians. At the meeting of that body last year at Oslo, the first steps were taken towards the formation of the new Comité. Most benevolent and practical interest in the Comité International has been evinced by the permanent office of the parent body, and especially by its distinguished secretary, M. l'Héritier. It is consonant with our experience of other intellectual movements that the stimulus towards studies on the history of science has come not from governments nor even from universities, but from voluntary associations of individual workers. As the heroic figure of the movement for the study of the history of science, we may cite Dr. George Sarton, a Belgian who is now domiciled in the United States. His self-sacrificing industry was interrupted but not deflected by the European upheaval. He has now the satisfaction of watching the growth of the History of Science Society, which has honoured itself by contributing some part of the cost of Sarton's remarkable journal *Isis*. The History of Science Society has its centre in Washington. It numbers many Europeans among its members, and welcomes all who take interest in the history of science.

The newly-formed Comité International d'Histoire des Sciences has its seat in Paris. The Comité itself will consist exclusively of persons actively engaged in investigating problems within the field of the history of science and technology. It will comprise 30 *membres effectifs* and 50 *membres correspondants*. They will meet annually in Paris, while every three years they will hold larger international congresses. The Comité is of course in active co-operation with the larger History of Science Society, to which all of its members belong, and there is no sort of rivalry between the two bodies.

The first president of the Comité International d'Histoire des Sciences is the very distinguished Italian mathematician and writer on the history of mathematics, Prof. Gino Loria of Genoa. The honorary secretary is Prof. Aldo Mieli, distinguished both for his own writings on the history of science and for the journal *Archeion* edited and published by him. The success of the recent Paris meeting of the Comité was mainly due to the admirable organisation of Prof. Mieli.

The French Government has allotted to the Comité a beautiful home in the Hôtel Nevers, a seventeenth century house which formerly belonged to Mme. de Lambert and afterwards held the first nucleus of the Bibliothèque Nationale. Here Prof. Mieli is organising a Centre International d'Histoire des Sciences, in which he will be assisted by Mme. Hélène Metzger, author of important contributions to the history of chemistry and physics. Madame Metzger will act as archivist and librarian.

In the Hôtel Nevers the members of the Comité recently assembled, the constitution of the Comité was agreed upon, and a number of most interesting papers were read. Among them were contributions both by the president and by Prof. Ruska of Berlin on the importance of Arabic manuscripts for the study of the history of mathematics; by Prof. Thorndike of Columbia University, president of the History of Science Society, on a treatise on surgery ascribed both to John Braccia and to Peter of Tossignano; by Prof. Mieli on Spallanzani and his relationship to Redi and to Pasteur; by Prof. Dingler of Munich on Nicholas of Oresmes; by Prof. Darmstaedter of Munich on his remarkable experiments to elucidate the formation of copper and silver alloys described in ancient treatises of alchemy; by Prof. Sigerist of Leipzig on the organisation of medical historical research; and by Dr. Feldhaus of Berlin on his Institute for the History of Technology. Prof. Vetter of Prague described the holograph manuscript of the "De Revolutionibus Orbium Celestium" of Copernicus, now at Prague. He discussed the interesting divergences between the manuscript and the first printed edition, and it was agreed that the manuscript should if possible be published in facsimile as an important historical document.

One session, attended by many distinguished visitors, was devoted to a commemoration of the work of the late Paul Tannery, who not only himself made important contributions to the history of science, but also, so early as 1903, at the International Congress of Historians in Rome, foreshadowed the creation of a permanent international body for the study of the history of science.

Paris opened its hospitable doors to the Comité. A dinner was given by the parent Comité International des Sciences Historiques, and a reception by the Institut International de Coopération Intellectuelle. The latter was the occasion of an eloquent address by the assistant director of the Institut, Prof. Alfred Zimmern, who expressed the hope that, through the history of science and cognate synthetic movements, it might be possible for the mind of the savant to exercise its legitimate influence in the international comity of nations.

Dr. Charles Singer was elected president of the Comité International d'Histoire des Sciences for the next two years, and it was decided to hold an international congress in London in 1931.

Meteorology in British East Africa.

THE first *Memoir* of what is to be known as the British East African Meteorological Service, from the pen of its director, Mr. A. Walter, formerly director of the Royal Alfred Observatory, Mauritius, has recently been received. This memoir describes the circumstances leading up to the inauguration of a joint meteorological service for British East African territories. The money for the undertaking is to be contributed by the Governments of Egypt, the Sudan and Zanzibar, and those of the East African colonies Uganda, Kenya, Tanganyika, and Northern Rhodesia; the Egyptian Government is intimately concerned with the acquisition of meteorological information from the East African uplands, the rainfall of which controls the Nile flow, and not inappropriately makes the largest financial contribution. For many years records of rainfall and temperature have been collected by the agricultural departments of Kenya, Uganda, and Zanzibar, and Tanganyika possessed a fully organised meteorological service when under German rule.

The new service begins with funds amounting to nearly £7000 a year and is able to undertake a comparatively ambitious programme involving the organisation of five 'first order' stations, where the work will include electrical and magnetic observations, measurements of solar radiation, and the exploration of upper wind currents by means of pilot balloons. In addition, there will be about forty 'second order' telegraphic reporting stations, at which observations

of atmospheric pressure, wind direction and velocity, rainfall and cloud, will be made twice a day. The stations will be important in connexion with weather forecasting for the air services, and it is hoped that they will assist the forest advisers of Government in the problem of the progressive desiccation of Africa.

The fact that the funds necessary for the launching of such a large meteorological service in a few years were forthcoming, taken in conjunction with the slow growth of European services in the latter half of last century, shows the extraordinary increase of recognition of the value of applied science that has taken place within the last ten or fifteen years.

University and Educational Intelligence.

CAMBRIDGE.—At Emmanuel College the studentship offered to a student of another university intending to begin research in Cambridge in October 1929 has been awarded to Mr. J. K. L. MacDonald, of McGill University, Montreal, for research in physics. The following awards have been made from the Research Fund to members of the College: Studentships of £150 each for two years to N. W. Pirie (biochemistry) and S. Clay (botany); grants to J. G. A. Griffiths (physical chemistry) and E. W. Pickford (psychology).

Mr. E. T. C. Spooner has been elected to a research fellowship at Clare College. Mr. Spooner was placed in the first class of the Natural Sciences Tripos, Part II. (pathology) in 1925 and was elected to a Commonwealth Fellowship tenable at Harvard in May 1929.

DURING the next few months about a hundred officers will be required by the Royal Air Force for flying duties under the short service commission scheme. Applications are accordingly invited from well-educated candidates of good physique who are between the ages of eighteen and twenty-five years. During their period of service, short service officers have opportunites for preparing themselves for civil life; a competitive examination is also held annually, and from this a limited number of short service officers are appointed to specialist courses in engineering, wireless telegraphy, armament, etc., with the view of obtaining permanent commissions in the Royal Air Force. Particulars can be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

FROM the Universities of Cambridge and Leeds we have received pamphlets containing abstracts of theses approved for research degrees during 1927–28. The Cambridge dissertations are classified as follows: chemistry 12; physics 10; biochemistry 7; botany 3; geology 3; zoology 2; mathematics 2; agriculture 2; engineering 1; metallurgy 1; experimental psychology 1; pathology 1; physiology 1; English, history, languages, and law, 9. Of the fifty-six authors (of whom six were women), thirty-one had come to Cambridge from other universities, namely, from other universities in Great Britain 12, from North America 7, Australia 4, South Africa 3, India 2, Ireland 1, South America 1, Russia 1. The Leeds pamphlet, which includes also lists of other researches and publications by members of the staff and graduate students, gives abstracts of theses as follows: in chemistry 8 (including 6 in colour chemistry), botany 5, mathematics 2, gas-engineering 1. Though somewhat belated, the publication of these abstracts, running in most cases to five or six hundred words, should prove useful to other research workers.

THE International Federation of University Women has issued a bulletin of 104 pages containing a report of its council meeting held in Madrid last September including reports of 28 national associations and a list of international club-houses and hotels. Founded ten years ago, it has steadily extended its membership and it now embraces almost every country in Europe, the United States of America, Canada, Mexico, South Africa, Australia, New Zealand, and India. Furthermore, ground is being broken in South America, Chile and Ecuador were represented at the meeting by Mlle. Mistral, technical adviser for Spanish America at the International Institute for Intellectual Co-operation, and the adhesion of associations of university women in most of the South American republics in the near future is confidently anticipated. The function of the Federation in relation to the university women of all these countries is, declared its president, Dr. Ellen Gleditsch, of Oslo, in a public address at Madrid, "to act as a catalyst in the chemistry of international relations". One of its chief enterprises is the establishment of international fellowships to enable scientifically trained women to study in countries other than their own. As yet the endowment fund does not permit the award of more than one fellowship annually, but there are others available within the organisation, such as the two recently offered by a member of the Australian federation, one offered by the American Association, and the residential scholarships offered by the Paris Club and by Crosby Hall in London. A campaign for raising a capital sum of a million dollars for this purpose is in progress. The Federation is financed mainly by contributions from the United States.

FROM the Kent Education Committee we have received a copy of "Education in Kent, 1923–1928", by E. Salter Davies, the County Director of Education. This volume, comprising a report covering 180 pages and numerous tabular statements, plans of buildings, and photographs, constitutes a record (to use the author's words) of "five strenuous and difficult years of self-examination, stocktaking, and reconstruction", and contains much valuable evidence of modern tendencies in English education. Very conspicuous are the evidences of the far-reaching effects on organisation, staffing, curricula, training of teachers, and buildings of the modern emphasis on individual differences. In a chapter on the reorganisation of elementary schools the report details the steps taken and planned, in accordance with the principles set out in the Board of Education's pamphlet, "The New Prospect in Education" of 1928 (sequel to the Hadow Report of 1926) towards the provision for *all* adolescents (ages 11-15) of "realistic and eminently practical forms of education which will develop the capability of the pupils to the full according to their several abilities and will equip them for their work in life". To ensure efficient classification and differentiation between pupils of different types of capacity and of different aptitudes, the committee has for some years provided facilities for obtaining training in the testing of individual capacities. In selected areas it has prescribed the use of a pupil's record card on which are recorded year by year the results of applying certain psychological tests. There has been, the report says, a very decided increase of late in the study of elementary science, particularly on the practical side. The supply of science apparatus is centralised through the Committee's Stores Department, which last year spent £4672 on it out of a total budget of £103,491. For elementary botany a microscope set is made to the committee's specification by a firm of engravers in the county.

Calendar of Patent Records.

August 18, 1835.—Numerous modifications of the steamboat paddle-wheel designed to reduce splashing and loss of power on entering and leaving the water were invented in the early days of steam navigation. One of the best known is the cycloidal wheel, in which each float, instead of being a single piece, is composed of several pieces of narrow width set one in advance of the other along the line of a cycloidal curve. Originally suggested by Joshua Field in 1833, this wheel was first patented by Elijah Galloway on Aug. 18, 1835. The wheels were used on the City of Dublin steam packets and were extensively adopted. Galloway was also the inventor six years earlier of a wheel in which the blades were automatically feathered. This wheel was successfully applied by William Morgan, by whose name it is usually known.

August 19, 1791.—On Aug. 19, 1791, there was granted in France a patent to Le Bas of Paris for "Moyens et procédés pour conserver et rendre à Paris, ainsi que dans tout le royaume, du poisson de mer et de rivière très frais et même vivant",—the first for the transportation of fresh food for long distances. The fish were to be conveyed in double-walled wagons, the space between the walls being filled with ice and salt, and replenished at allotted places on the way.

August 21, 1841.—The first incandescent electric lamp patent was granted to Frederick De Moleyns of London on Aug. 21, 1841. The lamp consisted of an exhausted glass globe in the upper part of which was a tube open at the bottom and containing powdered charcoal and a platinum wire which ran through the tube and was coiled at the lower end. A second wire, coiled at its upper end and nearly touching the first, came up through the lower portion of the globe. The powdered charcoal filled the two coils and bridged the gap between them, and was heated to incandescence on the passage of a current, any charcoal that was burnt up being replaced from the supply in the tube.

August 22, 1781.—Though an agricultural drill for sowing seed, the invention of Locatelli, an Austrian living in Spain, was described in the *Philosophical Transactions* for 1665, and the advantages of the use of such an implement were loudly proclaimed by Jethro Tull in his "Horse-hoeing Husbandry" published in 1731, it was not until Aug. 22, 1781, that the first patent for a machine drill was granted—to Thomas Proud of Bagley in Yorkshire, who attached the drill to the side of a common plough beam.

August 22, 1850.—The first method of mechanical refrigeration to come into general use was by means of compressed air, and the pioneer of this system was the American, Dr. James Gorrie, whose English patent was granted, in the name of the agent, W. E. Newton, on Aug. 22, 1850. Plant, built by James Watt and Co., was erected in London, but was not commercially successful and it was some years before the apparatus was perfected. Sir William Siemens made a valuable report on the Gorrie plant and suggested improvements for which he applied for a patent, though this was not proceeded with.

August 23, 1780.—James Pickard's patent for the application of the crank to the steam engine, which caused James Watt to invent his sun-and-planet movement as an alternative method of producing the rotary motion, was granted on Aug. 23, 1780.

August 23, 1815.—Seidlitz powders date from the patent granted to Thomas Field Savory, of New Bond Street, on Aug. 23, 1815, for his "discovered and combined neutral salt powder which possesses all the properties of the medicinal spring at Seidlitz in Germany". The patent was declared to be invalid in the courts, but the name caught the public fancy.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 25.—Irish Radium Committee Report for the year 1928. A brief history is given of the foundation of the Irish Radium Institute in 1914 and of the invention by Dr. Joly of the needle method of treatment. Reports are included from medical users on the treatment of 291 patients during the year 1928; in many cases the results were very successful.—**H. A. Cummins, Violet E. C. Kennelly, and M. Grimes**: A study of fungi found in milk. Among samples of milk examined in the Department of Dairy Bacteriology, University College, Cork, during the first five months of this year, twenty-one species of fungi were found, many of which had not previously been reported in milk.—**P. A. Murphy and R. McKay**: Some insect vectors of virus diseases in plants. A list found by various workers to be capable of conveying leaf-roll, both aerially and through the soil. In experimental work with aphides extending from 1922 until 1928, the number of successful leaf-roll infections secured with *Myzus persicæ* were 19 out of 25; with *Myzus pseudosolani*, 2 out of 40; with *Macrosiphum solanifolii*, 1 out of 151; and with unidentified aphides, 5 out of 34. Insects other than aphides play no appreciable part in causing infection in the field. *M. persicæ* is capable of conveying infection from sprouting tubers, young plants, or full-grown plants to sprouting tubers, young plants, and full-grown plants. The younger the inoculated plant, and apparently also the younger the plant providing infection, the quicker the symptoms develop on the former. This is correlated with greater ease of infection in the earlier stages of growth. Plants infected early in the season generally give rise to a totally diseased crop in the following year. The tubers of those inoculated late in the season may escape infection altogether, or some of them may become diseased and some remain healthy.—**L. P. W. Renouf**: A hydrographical and biological study of Lough Hyne, Co. Cork.—**J. Reilly**: (1) An investigation of the polysaccharides. (1) Inulan. (2) The cryoscopic constants of acetamide.—**J. H. J. Poole**: A suggested new type of sensitive, suspended needle galvanometer. By the use of a high-permeability core, the sensitivity of an astatic galvanometer may be much increased if difficulties connected with the demagnetisation of the core can be overcome.

PARIS.

Academy of Sciences, July 8.—**Charles Richet**: Some statistics concerning the foreign associates and corresponding members of the Academy of Sciences. Details of age at election, age at death, period of membership and nationality.—**Gabriel Bertrand and Mme. C. Voronca-Spirt**: Titanium in cryptogams. Ferns, algæ, and fungi were analysed, care being taken to avoid contamination with earth or dust. Titanium was generally present in the proportion of some milligrams per kilogram of material. Negative or doubtful results were obtained in a few cases, including yeast and *Aspergillus niger*.—**L. Léger and O. Duboscq**: The evolution of *Paramœbidium*, a new genus of Eccrinideæ, a parasite of aquatic larvæ of insects.—**B. Hostinsky**: The probabilities of phenomena connected in Markoff's series.—**N. Lusin**: The problem of implicit functions.—**Radu Badesco**: An integral equation.—**Guido Ascoli**: The approximation of functions.—**J. Haag**: The extension of Phillips's conditions concerning the balance wheel.—**J. Ph. Lagrula**: The rapid location of the photographic position of a minor planet or non-catalogued

star by the method of Schlesinger.—**A. Grebel**: The variation of the temperature of spontaneous combustion of petrols to which different substances have been added. The measurements were made in Krupp's modification of Moore's apparatus, the anti-knock compound being added in proportions varying from 0 per cent to 100 per cent. The curves showing the ignition temperature as a function of the amount of antidetonant added are discontinuous, generally two or more straight lines. 'Motyl' (solution containing 25 per cent iron carbonyl) was much more efficient than 'ethyl' (50 per cent lead ethyl).—**Emmanuel Dubois**: The Volta effect in steam and in hydrogen.—**Witold Kessel**: The complexity of the terms of the resonance spectrum of tellurium vapour.—**Picon**: The action of high temperatures on some metallic sulphides. The type of carbon resistance furnace employed gave temperatures up to 2000° C. The sulphides of molybdenum, tungsten, and uranium, as well as aluminium and magnesium sulphides, are volatile and dissociable in a vacuum, at 1200° to 1300° C. Pure crystallised sulphides of these metals cannot be obtained by distillation.—**A. Andant**: Some relations between the chemical constitution, absorption, and fluorescence of the alkaloids.—**J. Duclaux** and **R. Titeica**: Micellary equilibria and membrane equilibria. Experiments are cited proving that for a given hydrosol, the composition of the liquid after ultrafiltration is independent of the pressure of filtration. It is not changed when the concentration in solid particles is increased and is independent of the nature of the membrane used as the ultra-filter (cellulose, nitrocellulose, acetocellulose).—**Ernest Morlet**: Copper-aluminium alloys containing manganese, tin, and cobalt.—**Weizmann** and **L. Haskelberg**: Researches on the preparation of glycerol esters of the fatty amino-acids.—**Georges Mignonac** and **René Vanier de Saint-Aunay**: The polymerisation of ethylene by the silent discharge. The synthesis of butene and hexene. The gas was rapidly circulated through the apparatus and the products cooled to − 60° C. The hydrocarbons were identified by means of their ozonides and included butene, $CH_3-CH_2-CH=CH_2$ and hexene, $CH_3(CH_2)_3CH=CH_2$.—**G. Allard**: The crystalline structure of thorium boride.—**H. Parent**: Observations on the age and sense of the Corsican orogenic movements.—**Gruvel**: Some oceanographic peculiarities observed on the coasts of Syria.—**Maurice Melcion**: A form of (electrical) discharge at atmospheric pressure.—**Paul Guérin**: Papilionaceous Lotus containing a cyanogenetic glucoside.—**Ch. Brioux** and **Edg. Jouis**: The active lime of basic slag and of disintegrated phosphates.—**J. Millot**: The cephalothoracic gland of a spider, *Scytodes thoracica*.

LENINGRAD.

Academy of Sciences.—(*Comptes rendus*, No. 6).—**V. Mitkevich**: (1) The transformations of magnetic flux. In an ideally uniform toroidal coil wound around an absolutely symmetrical ring core, there must be formed, as a result of the transformations of the separate magnetic links connected to the individual turns of the coil into the common magnetic flux, first, closed magnetic lines inside the core, and, secondly, independent magnetic rings, completely disconnected from this magnetic flux.—(2) The anomalous magnetic flux. In ordinary conditions the anomalous component of the magnetic flux is comparatively so small that it can be neglected. But in some cases, and especially in the case of sufficiently high frequencies, the anomalous flux and its action can become appreciable.—**N. Annenkova**: Polychæta from the relic lake Palæostom (Western Caucasus) and the rivers connected with it. Only two species were found, namely, *Nereis succinea* (Leuckart), known hitherto from the Atlantic Ocean, Mediterranean Sea, the Suez Canal, and the Black Sea; and *Mercierella enigmatica* Fauvel, known from the Mediterranean Sea and the English Channel.—**K. Domin**: A new variety of *Kœleria gracilis*. A description of *Kœleria gracilis* Pers. var. *Bushiana* nov., from the Caucasus.—**I. E. Znamenskii**: Changes occurring in the cytological structure and some physiological processes in the cells of *Mnium cuspidatum* under the influence of dehydration. The chloroplasts in a cell of *Mnium* subjected to a loss of water either by freezing, drying, or treatment with plasmolytic substances always form similar groups. The retinal structure is the same in the cells of the plant taken from under the snow, and in artificially dehydrated cells. The chloroplasts begin to lose their normal shape at 88 per cent of relative moisture.—**N. N. Netchayeva**: Action of X-rays on animal organisms. Experiments with X-rays on *Daphnia* showed that with the increase in the duration of irradiation by X-rays the rate of mortality decreases, reaching finally a minimum value; with still further irradiation the rate increases again.—**B. N. Mogilnitskii**: The action of Röntgen rays on the nervous tissue. Although the most delicate methods used in the experiments failed to discover any alterations in the brain cells after irradiation, it still appears that the normal physiological condition of the brain is affected.

Comptes rendus, No. 7.—**V. N. Ipatiev** and **A. D. Petrov**: Hydrolysis and cracking of naphthenic acids at high temperatures and under high pressure. Under atmospheric pressure, olefines result; under a high pressure, carbohydrates of the paraffin and naphthene series.—**V. N. Ipatiev, A. D. Petrov**, and **I. Z. Ivanov**: An experiment on the cracking of a primary tar from a Donetz coal under pressure in a hydrogen atmosphere. By varying the conditions of cracking under pressure, it is possible to obtain substances with a greater or smaller content of aromatic carbohydrates.—**V. N. Ipatiev, N. A. Orlov**, and **M. A. Belopolskii**: The cracking of a petroleum tar under high pressure in a hydrogen atmosphere.—**V. N. Ipatiev, N. A. Orlov**, and **N. D. Lichatchev**: The cracking of some organic compounds under high pressure in a hydrogen atmosphere. A primary tar heated for a short time in the presence of hydrogen produces about 30 per cent of light benzenes, no coke being formed.—**V. N. Ipatiev, G. A. Razuvaev**, and **I. F. Bogdanov**: The replacement of metals in the organo-metallic compounds by hydrogen under high pressure. The reaction goes on according to the equation: $Pb(C_6H_5)_4+2H_2=4C_6H_6+Pb$. At a pressure of 60 atmospheres and temperature 250° C., the quantity of replaced lead reaches 100 per cent.—**S. Kostytchev** and **C. Egorova**: The supposed rôle of the glyceric aldehyde and glyceric acid in alcoholic fermentation. Neither the glyceric aldehyde nor the glyceric acid is an intermediate product of alcoholic fermentation.—**S. P. Kostytchev** and **O. G. Shulgina**: The microbes producing alcohol in the maceration juice of yeasts. The theory of extracellular fermentation is not proved, but not improbable.—**V. B. Sotchava**: A new species of *Bromus*, *B. vogulicus*, sp. n. The new species is described from the Alpine region of the Northern Ural mountains.—**S. L. Sobolev**: Notes on the papers by N. N. Saltykov, "Researches in the Theory of Equations".

SYDNEY.

Linnean Society of New South Wales, Mar. 27.—**W. R. Browne** (Presidential address): An outline of the history of igneous action in New South Wales until the close of the Palæozoic era. Evidence of vulcanicity is recorded in the strata of all the Palæo-

oic systems represented. No certain traces of conti-ental vulcanism prior to that of Kuttung times have een discovered. The Kuttung epoch of freshwater Carboniferous) sedimentation closed with subsidence nd marine transgression, but the preceding Burindi poch of marine deposition was ended by a folding iovement localised in New England and gradually ying out to the south and west. A similar localised iovement commenced at the close of the Upper Iarine (Permo-Carboniferous) epoch. Igneous intru-ion occurred in connexion with all the orogenic move-ients, the rocks being calcic, usually of granitic haracter, but ranging to basic and ultra-basic. The Devonian intrusive epoch resulted in the most wide-pread and important series of intrusions, comprising ijections of both plutonic and hypabyssal habit; and is worthy of note that the late Permo-Carboniferous ntrusions, confined to New England, bear quite a lose resemblance to those of the Kanimbla (Devonian) poch, both petrologically and in the nature of the ssociated ore-deposits. The ultra-basic rocks of the Great Serpentine Belt were injected in closing Burindi imes. The latest Palæozoic eruptive episode was ossibly the injection of the alkaline-monzonite series f Mount Dromedary, on the south coast, in a place and t a time of vertical crustal movement.—**M. Bezzi**: ustralian Pyrgotidæ (with an appendix by **J. R. Malloch**). The family is not a large one in number of pecies, but is present in all the zoological regions. Eighty-eight described species are listed.—**J. R. King-orn**: Description of a species of lizard from the ighlands of New South Wales and Victoria, which as for many years considered to be the Tasmanian orm, *Lygosoma pretiosum*, but is found to be more losely related to *L. entrecasteauxi* and is regarded as distinct species.—**H. Claire Weekes**: On placentation reptiles (1). Placentation among snakes is de-cribed for the first time. As most of the venomous nakes in Australia at least are viviparous, it is prob-ble that placentation among them is not uncommon. t the stage described, the snakes *Denisonia superba* nd *D. suta* have no omphaloplacenta, as the allantois as completely encircled the yolk-sac. Omphalo-lacentation and allantoplacentation are also de-cribed for a new species of *Lygosoma*. This type is nteresting, because it suggests a stage in the develop-ient of the placenta intermediate between that in ne lizards *L. quoyi* and *L. entrecasteauxi*.—**Ida A. rown**: Preliminary note on monzonitic and nephe-ne-bearing rocks of Mount Dromedary, N.S.W. At lount Dromedary there is a monzonitic plutonic com-lex in which acid, intermediate, basic and ultra-basic hases are represented by banatite, monzonite, olivine-onzonite, kentallenite, and pyroxenite. A further esult of differentiation has produced a number of are types. This is the first record in Australia of a omplete series of plutonic monzonitic rocks.

May 29.—**H. J. Carter**: Revision of the Australian horacanthini (fam. Cerambycidæ), with notes and escriptions of new species of this group and of allied enera. **C. P. Alexander**: Notes on the Australian pecies of *Molophilus* (Tipulidæ, Diptera). A key is ven for the separation of the Australian species into roups, and the twelve species described by Skuse in 889 are ranged in their groups and their affinities dis-ussed.—**A. S. Hitchcock**: Papuan grasses collected y L. J. Brass. Twenty-one species are recorded, in ddition to one species of *Isachne* which is described new.—**A. B. Walkom**: Note on a fossil wood from entral Australia. A coniferous wood from the retaceous glacial beds at Muloowurtina, Central ustralia. The wood shows well-marked narrow annual ngs, indicative of regular seasonal change in climatic onditions, but not necessarily of glacial conditions.

Vienna.

Academy of Sciences, April 18.—**F. M. Exner**: Gravitation waves in the atmosphere. In essence, diurnal pressure and temperature changes appear to be nearly identical with the phenomena of gravitation waves.—**F. Heritsch** and **H. R. v. Gaertner**: Devonian petrifactions from Paphlagonia.—**K. Lohberger**: Some new fish forms from Lake Victoria.—**O. Scheerpeltz**: Staphylinidæ from Palestine and Syria. Zoological expedition by R. Ebner, 1928.—**A. Himmelbauer**: Apatite-twins from Elba. Crystals are described with a rotation in the plane of symmetry.—**E. Furreg** and **F. Querner**: Peculiar fluorescence phenomena in the shells of gastropods (families Trochidæ and Turbinidæ). Filtered ultra-violet light was used of wave-lengths between 400 and 300 $\mu\mu$. The method appears useful for detecting the presence of definite pigments even when overlaid by others.—**V. F. Hess**: New investigations on the ionisation balance of the atmosphere over Heligoland. Observations were made on the north point of the island and 50 metres above sea-level. Numerical results varied with direction of the wind, with visibility, and with spray.—**H. Cammerloher**: The larva of *Anthocephalus elongatus*.—**T. Pintner**: Studies of Tetrarhynchi with observations on other tapeworms (4). Some of Diesing's originals and related forms.—**F. Werner**: Scientific results of a zoological expedition to Algeria and Morocco (2). New Orthoptera.—**R. Ehrlich**: The periodic series of colour sensations, with an appendix by **R. Schumann**: Mathematical investigations of a series appearing in the theory of colour sensations.—**S. Meyer**: The question of the formation of neutrons. A mathematical discussion of the combination of protons and electrons and possible explanation of γ-rays.—**A. Basch**: Error-tensors, error-affinors, and general error transport laws.

April 25.—**H. Balss**: Expedition of the *Vola* to the Red Sea, northern and southern half, 1895–96 and 1897–98. Zoological results. Decapods of the Red Sea (4). Oxyrhyncha and final comments.—**F. Sigmund**: The action of ultra-violet rays on aldehydes. Studies on hexahydro-phenyl-acetic aldehyde, hexa-hydro-β-phenyl-propionic aldehyde and n-dodecyl-aldehyde.—**F. Lieben** and **E. Molnar**: The oxidative decomposition of some physiologically important bodies by the process of Hehner.—**G. Jantsch** and **K. Meckenstock**: Chromium (iii)-p-toluol-sulphonates.—**K. Przibram**: Piezochromy (change of colour under pressure) in natural minerals.—**E. A. W. Schmidt** and **G. Stetter**: The use of the valve-electrometer for the investigation of proton-rays.

May 2.—**M. Holly**: Some new fish forms from Brazil.—**O. Gugenberger**: Geological studies from the Upper Etsch (Alto Adige) with special reference to glacial problems.—**A. Wagner**: Influence of the thermometer exposure on temperature registration in Vienna Hohe Warte.—**E. Clar**: A contribution to the knowledge of the lead-zinc ore deposits of Schönstein near Cilli in Jugoslavia.—**W. Leithe**: The rotation, refraction, and volume of organic bases in solution.—**K. Zindler**: Parallel plane sections of a convex body.

May 10.—**H. V. Graber**: Report on geological petrographic researches in the Upper Austrian primitive rocks (2).—**F. E. Suess**: Tectonics of the Scotch Caledonians. The results of a visit to the Moine district and of the British Association excursion to Ballachulish. The geological structure of Scotland is compared with Alpine, Variscan, Scandinavian, and Moravian structure.—**Y. Abe**: Sexual differences of cell size in albino rats. Female cells about 95 per cent of the size of cells in the male.—**P. Walden**: Landolt Oudeman's law in non-aqueous solutions.—**L. Moser**:

Extension of method of gravimetric analysis.—**M. Kohn** and **A. Aron**: Debromination of brominated cresols with zinc dust and acetic acid.—**L. Kober**: Report on geological investigations in Attica.—**A. Musil**: Thermodynamic relations between lye and soda saponification of esters.—**A. Dadieu** and **K. W. F. Kohlrausch**: Studies on the Raman effect (2). The Raman spectrum of organic substances (benzol derivatives).—**K. Przibram**: Recrystallisation and coloration of rock-salt.—**L. Walchshofer**: Volatilisation of radium B and radium C as dependent on the nature of their substratum.—**F. Urbach**: Absorption bands of solid bodies.—**F. Urbach**: Stokes's law.—**R. Mayer**: Morphology of the middle Burgenland.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 4, April 15).—**Richard C. Tolman**: On the possible elements for the universe. Einstein's and de Sitter's line elements, with that given by the special theory of relativity, are the only ones compatible with the usual assumptions as to the physical nature of the universe and with general relativity.—**Lora Lane Loeb** and **Leonard B. Loeb**: The existence of radioactive recoil ions of high mobility. The ionisation chamber consisted of an ebonite ring separating two brass plates through holes in which the discs serving as radioactive source and detector respectively could be inserted. Rutherford's alternating current method and a short period source were used. No evidence was obtained of high velocity ions.—**William T. Richards**: An intensity gauge for 'supersonic' radiation in liquids. A glass gauge, on ear-trumpet principle, of exponential form and thick-walled, gives the best results, the concentrated sound energy being measured as a hydrostatic pressure. If it could be calibrated, it could be used as an absolute gauge.—**V. Guillemin, Jr.**, and **C. Zener**: Hydrogen-ion wave function.—**S. A. Ratner**: Latent carriers of electricity in the gaseous discharge. A gauze ionisation chamber was placed inside a pile of parallel circular annuli; the 'pile' formed one electrode and an external metal rod the other. In spite of a potential difference between each pair of annuli, large currents were measured by the ionisation chamber, due presumably to metastable atoms which diffuse into it.—**Hermann Weyl**: Gravitation and the electron. Mathematical development of a field scheme.—**Roscoe G. Dickinson** and **Robert T. Dillon**: Raman spectra of solutions of some ionised substances. Frequency changes appear to be independent of the nature of the positive ion.—**A. J. King**: The crystal structure of strontium. Powder diffraction data indicate a face-centred cubic structure, the unit cube edge being 6·075 A. and the distance between strontium atoms 4·295 A.—**Chas. W Metz**: Selective segregation of chromosomes in males of a third species of *Sciara*.—**Thomas Harper Goodspeed** and **Priscilla Avery**: The occurrence of chromosome variants in *Nicotiana alata* Lk. et Otto.—**Edward W. Berry**: An eocene tropical forest in the Peruvian desert. Silicified fruits and seeds from a thin outcrop near Punta Pariñas indicate that in Tertiary times the region supported a forest cover of tropical vegetation; the rainfall of the region was much greater than at present and well distributed through the year.—**B. P. Gerasimovič**: On the stability of gaseous stellar structures. An analysis of Jeans's stability criterion. If changes of ionisation of a star in a perturbed state are taken into account, not only dwarfs and giants but also supergiants are stable in the gaseous state. Certain stars of very large mass may be 'liquid'.—**N. Wiener** and **M. S. Vallarta**: On the spherically symmetrical statical field in Einstein's unified theory of electricity and gravitation.—**D. G. Bourgin**: Unimolecular reactions Application of new quantum theory considerations.—**J. Dieudonné**: A generalisation of Rolle's theorem with application to entire functions.—**S. Lefschetz**: Duality relations in topology.—**G. A. Miller**: Groups which admit three-fourths automorphisms.—**A. Adrian Albert**: The rank function of any simple algebra.—**M. S. Knebelman**: Conformal geometry of generalised metric spaces.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Victoria. Vol. 41 (New Series) Part 2, 11th April. Pp. 65-242+plates 12-24. (Melbourne.)

Department of Scientific and Industrial Research. Building Scienc Abstracts. Compiled by the Building Research Station and published i conjunction with the Institute of Builders. Vol. 2 (New Series), No. June. Abstracts Nos. 1026-1279. Pp. v+207-247. (London: H.M Stationery Office.) 9*d*. net.

Ceylon Journal of Science. Section B: Zoology and Geology. Spoli Zeylanica. Edited by Dr. Joseph Pearson. Vol. 15, Part 3: A Mono graph on Cestodes of the Order Trypanorhyncha from Ceylon and India Part 1. By Dr. T. Southwell. Pp. 169-312. (Colombo: Colombo Museum London: Dulau and Co., Ltd.) 3 rupees.

University of Mysore. Report on the Statistical Analysis of the Medica Examinations (1924-25 to 1926-27) of Students of the Mysore University By Prof. K. B. Madhava. Pp. 80. (Mysore: Government Branch Press

Transactions of the Optical Society. Vol. 30, No. 4. Pp. iv+141-184 (London.) 10*s*.

Empire Marketing Board, May 1928 to May 1929. (E.M.B. 19.) Pp. 54 (London: H.M. Stationery Office.) 1*s*. net.

Leeds University: Department of Pathology and Bacteriology. Annua Report, 1928, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; wit Abstract Report on Experimental Pathology and Cancer Research, b Prof. R. D. Passey. Pp. 16. (Leeds.)

Medical Research Council. Ninth Annual Report of the Industria Health Research Board (formerly the Industrial Fatigue Research Board to 31st December 1928. Pp. 33. (London: H.M. Stationery Office. 9*d*. net.

FOREIGN.

Proceedings of the United States National Museum. Vol. 76, Art. 1 New Fossil Land and Fresh-water Mollusks from the Reynosa Formatio of Texas. By William B. Marshall. (No. 2798.) Pp. 6+1 plate. (Wash ington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service Bulletin No. 86: Piroplasmosis in Egyptian Fowls (Egyptianella Pullo rum). By Prof. M. Carpano. Translated by Zaki Morcos. Pp. 7+ plates. (Cairo: Government Press.) 5 P.T.

Department of the Interior: Bureau of Education. Bulletin, 1929, No 12: Work of the Bureau of Education for the Natives of Alaska. B William Hamilton. Pp. 6. (Washington, D.C.: Government Printin Office.) 5 cents.

Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri Bind 8, No. 7: On the Age and Growth of the Coalfish (*Gadus virens* L.) the Norway Pout (*Gadus esmarki* Nilsson) and the Poutassou (*Gadu poutassou* Risso) in Icelandic Waters. By Bjarni Sæmundsson. Pp. 37 (København: C. A. Reitzels Forlag.)

Secrétariat du Comité Météorologique International. No. 1: Rappor de la septième Réunion de la Commission Internationale des Renseigne ments synoptiques du temps à Londres, mai-juin 1928. Traduction e français du Rapport du président de la Commission avec des textes allé mands des résolutions. Pp. 79. (Utrecht: Kemink en Zoon.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Sapporo, Japan. Vol. 25, Part 3: On the Known and Unrecorded Specie of the Japanese Pyraustinae (Lepid.). By Jinshichi Shibuya. Pp. 15 242. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES.

Autumn Books, 1929. Pp. 16. (London: George G. Harrap and Co Ltd.)

The Nickel Bulletin: a Summary of Current Information on Nicke Vol. 2, No. 2, August. Pp. 64. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

SATURDAY, AUGUST 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEER (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESS.

AUGUST 29 TO SEPTEMBER 1.

SWISS SOCIETY OF NATURAL SCIENCES (at Davos). In seventeen Section Lectures:—Dr. W. Mörikofer: Problems of Meteorological Radiatio Research.—G. Bener: Mountain Road Construction and Science.—Pro R. Staehelin: The Physiology of High Altitudes.—Prof. E. Guyéno The Hypothesis of Morphological Territories in Biology.—Prof. Doerr: The Submicroscopic Forms of Life.

NATURE

SATURDAY, AUGUST 24, 1929.

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Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

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A Folk Museum for England.

In a recent note in our columns (Nature, July 27, p. 155) it was stated that the Council of the Royal Anthropological Institute had appointed a committee, the object of which is to explore the position in regard to the institution of a folk museum in England. It may at first sight seem a little remarkable that England alone in the British Islands has no museum illustrative of the life, art, and industries of the people in the past which can be called national. Many of the provincial museums include valuable and sometimes quite extensive collections of local 'bygones'. Yet although some admirable schemes for a national folk museum have been formulated at one time and another, nothing comprehensive for the whole country and centrally situated has actually been attempted.

One difficulty upon which stress has been laid—a difficulty indeed which has been put forward as an explanation of the non-existence of such a museum—is that the material likely to be available is inadequate for anything in the nature of systematic treatment. In Wales, in Scotland, and in Ireland, it is argued, the remoteness of many areas from large centres of industry, their difficulty of access and the lack of communications, at any rate until the recent extension of motor traffic, have favoured the survival of primitive modes of life, of simple methods in industry, and of implements elsewhere obsolete; while in England rural industries and peasant life are both more standardised and more highly mechanised. To a degree this is necessarily true. Within the last twenty-five years, or more particularly since the War, many old-time household utensils and implements have fallen out of use and been thrown aside or vanished into the keeping of unknown private collectors. But many landowners and farmers with a feeling for the past still carefully preserve these relics of an earlier system of cultivation and a more simple mode of life which perhaps still prevailed in their own younger days. Nor does it necessarily follow that because a tool or implement is primitive that it is everywhere obsolete, even in areas which are not remote. Local conditions keep them alive. In Buckinghamshire, for example, the peculiar type of cottage lathe of the wood turner is still employed; in Essex the wooden plough is still in use as that best suited to the character of certain soils.

Recent experience shows that owners of the objects needed for a collection illustrative of the country life in the past are ready and willing to co-operate by loan, by gift, or by sale when once their

interest is aroused, and will assist in the search for objects to add to the collection among the country cottages in their district. If once a folk museum were instituted, there is abundant evidence that material would accrue rapidly and in plenty.

It must, however, be admitted that as time goes on the formation of such a national collection becomes increasingly difficult. Only the more durable objects will tend to survive, and as many of these are not in themselves beautiful, they will be cast aside as interest in them and knowledge of their uses grows less. Large objects such as ploughs, waggons, and carts will be broken up through difficulties of storage. More than twenty years ago, stress was laid upon this point in urging the need for a folk museum. The question of time is still more insistent to-day, and unless steps are taken within a little to preserve these evidences of the life of the past, it will be too late.

The correspondence now appearing in the daily press on the preservation of windmills, as well as the success of the Royal Society of Arts in its efforts to secure the preservation of typical villages and dwelling-houses of rural England, is an index to the interest which is taken by a part at least of the public in the culture of an earlier day. It only awaits direction to find expression in practical form.

It is indeed remarkable that while this interest in the culture of the past is manifested almost daily by the general public, we in England should lag behind other countries in a systematic effort to satisfy it. We have ample experience in other countries to guide us. Folk museums have been established at Stockholm, Oslo, Copenhagen, Helsingfors, Budapesth, Sarajevo, and elsewhere. It at least stands to the credit of the Soviet government that it has fostered the growth of local folk museums, and these, if the periodical reports are to be credited, are visited by thousands every year.

It is frequently, indeed it may be said it is usually, forgotten that anthropology is the study of *all* that man is and *all* that man does. It covers not only backward peoples, and the men of the remote past, but it should also take within its purview the civilised races. So far as physical anthropology—the study of man's bodily structures and his racial affinities as a member of the genus *Homo*—is concerned, this is generally recognised. It is less widely understood that study of the culture of civilised communities—a study as intensive as that now devoted to the backward peoples—is equally essential in the evaluation of 'modern' man. As a matter of practice and even of convenience, in the long run, this intensive study of 'modern' man must take the form of the history of development in culture, static at any given point of time, developmental over the whole series, and perhaps best, or at any rate most frequently exemplified in the study of survivals; but as the late Sir Lawrence Gomme saw clearly, it must be the study of survivals pursued in no spirit of mere antiquarianism. It must be the study of a living past in which the present is rooted.

It is clear that a museum which is to be at once an exposition and in a sense a laboratory of research in national culture must be something more than a mere collection in show cases of objects brought together because they are curious or obsolete. In 1911–12 a suggestion was made for the utilisation of the Crystal Palace and its grounds as a National Folk Museum. It was then suggested that the museum should serve for the display of developmental series of furniture, pottery, glass, iron-work, textiles, etc., and for collections illustrating the customs, distinctive beliefs, amusements, personal ornaments, inventions, etc., of the English peoples. This scheme was of a rather wider scope than a folk museum in the usual sense, for it was intended that it should include typical interiors, such as 'Chippendale' and 'Hepplewhite' and other period rooms; thus following the lines of some continental museums. A room was to be devoted to the apparatus and methods of producing fire in past times, a room for children's toys and games, a folk-lore room, and so on. The most important element in the scheme for the utilisation of the Crystal Palace was, however, the suggestion that ancient buildings from different parts of the country should be acquired and re-erected in the grounds. These were to be placed in such a way that no incongruous effect was produced by the close proximity of buildings out of keeping with one another, and they themselves were to be provided with furniture and appliances in accordance with their size and period.

In this proposal the scheme followed the plan of the open-air museum at Skansen, which is an offshoot of the Northern Museum at Stockholm. Here typical peasant houses from different provinces and of different dates have been gathered together, with characteristic furniture congruous in period and type. This museum has been in existence since 1891, and has proved not only a great and popular success, but also it has been of enormous value in preserving objects illustrating the peasant culture of the country. A similar museum has recently been opened in Holland. In some of the

ontinental folk museums the idea has been carried o far that the attendants wear the distinctive pro-incial peasants' dress.

There can be no two opinions that an open-air nuseum of the type here suggested, illustrating the easant art and culture of England from the earliest imes for which material is available, would be of he greatest scientific and educational value ; nor an there be any question that buildings of the type lesired and of various periods can be obtained vithout any great difficulty. Nor would they be onfined to dwelling-houses. Windmills, water-nills, tithe-barns, oast-houses and so forth should e included. The proposal would in no way con-lict with the endeavours that are now being made o preserve peasant dwelling-houses and other uildings of historical and cultural interest. Every lay, unfortunately, cottages are being pulled down vhich these efforts cannot save, whereas if it were ossible that they could be re-erected as part of an pen-air museum, they would be preserved in per-etuity. It must also be remembered that the umber of buildings which could be accommodated n this way is strictly limited. Consideration of pace alone would preclude indiscriminate removal f interesting buildings—an objection which has een made to the scheme. It would lead rather to he preservation of at least some of which the de-truction was otherwise inevitable.

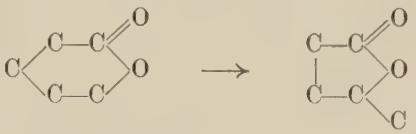
It is possible that the Royal Commission on the Jational Collections and Museums in its final re-ort will touch upon the question of folk museums, lthough there is little hope that any suggestion of n extension of the English National Collections in his direction will be made in view of financial and ther considerations. Two obvious difficulties tand in the way of any action. The first is that f a site. It is evident that for a museum of this ind to be utilised to the full and to obtain an dequate return for the expenditure of time and noney necessary for its establishment, it must be ituated in, or readily accessible from, London. nly so will it be utilised readily by the student or ill it attract the general public. Yet unless its pkeep is financially a matter of national concern, will have to depend upon admission fees for its ncome. This brings us to the second difficulty, nat of finance. In view of the claims at present ade upon the sums which are set aside for museum urposes, it is clear that for capital expenditure and lso, in the early days, for expense of upkeep, the ommittee will have either to find a generous bene-ctor or arouse sufficient public interest to secure a beral capital sum by subscription.

Chemistry of the Sugars.

The Constitution of Sugars. By Prof. W. N. Haworth. Pp. vii + 100 + 2 plates. (London : Edward Arnold and Co., 1929.) 8*s*. 6*d*. net.

THE most important development in the chemistry of the sugars since the classical researches of Emil Fischer is the discovery that the 5-atom ring system, which he assigned both to the sugars and to the lactones derived from them, is wrong as regards the sugars, although it is right as regards the lactones of the normal type. No clear explanation has yet been given to show why a six-atom ring should be more stable than a five-atom ring in the sugars,

whilst a five-atom ring is more stable than a six-atom ring in the lactones, where one of the carbon atoms is doubly bound to oxygen.



Nevertheless, this has now been established as a general proposition, which applies to the pentoses as well as to the hexoses and to the disaccharides as well as to the monosaccharides. Whilst, however, glucose in the natural glucosides is always found to be linked up as an α or β glucoside with a six-atom or pyranose ring, the isomeric fructose occurs in compounds such as sucrose as a five-atom or furanose ring derived from a labile γ-fructose, and it is mainly for this reason that the synthesis of cane-sugar has been so long delayed.

Emil Fischer's work was based on his discovery of the use of phenylhydrazine to give sparingly soluble crystalline derivatives from which the sugars could be recovered after they had been isolated as hydrazones or osazones. In the same way, the new work on ring-formation depends on the use of methylating agents, namely, methyl iodide and silver oxide (Purdie and Irvine, 1903) or methyl sulphate and aqueous alkali (Haworth, 1915). With the help of these agents every unused hydroxyl-group in a sugar (for example, five in glucose and eight in cane-sugar) can be turned into methoxyl, and as it were anæsthetised whilst the remainder of the molecule is being operated upon. When the necessary surgical operations have been performed the sugar can sometimes be recovered or restored to life, but more usually the subsequent

proceedings take the form of a post-mortem examination, whereby the physiology of the living sugar is deduced from the anatomy of the methylated residues.

Drastic processes such as these have been needed to eliminate Fischer's fundamental error in identifying the ring systems of the sugars with those of the common lactones, but in the future more importance may attach to the use of milder anæsthetics, such as the process of acetylation whereby Pictet, in 1928, ' fixed ' fructose in its labile γ-form and then united it with glucose, which had been fixed in the stable pyranose form by a similar process of acetylation. Elimination of the acetyl-groups then produced the real cane-sugar, which had eluded all the earlier synthetic workers. Amongst these milder anæsthetics we may include acetone, which forms an important series of condensation products of the acetal type (Fischer), which are stable to alkali but unstable in the presence of acid. Carbonates, which are unstable to alkalis but more stable to acids than the acetone compounds, can also be condensing sugars with phosgene in pyridine or alkaline solutions (Haworth). Finally, the use of the triphenylmethyl radical instead of methyl in the preparation of glucosides gives rise to products in which the characteristic properties of an ether are changed towards those of a salt, so that the radical can be eliminated with exceptional ease, like a mild local anæsthetic, when it has served its purpose and is no longer needed.

The revolutionary changes which have taken place in the chemistry of the sugars during the past ten years have been effected almost entirely by Prof. Haworth and his colleagues, who have been untiring in the laborious work involved in methylating both the six-ring sugars and the five-ring lactones, and then preparing from the products the methylated forms of the unstable five-ring sugars and the six-ring lactones. In this way the somewhat tentative earlier efforts to bring the rotatory powers of the sugars into line with C. S. Hudson's lactone rule have ultimately been realised, and the new six-atom ring formulæ have been established beyond dispute for glucose, galactose, mannose, fructose, arabinose, xylose, lyxose, and rhamnose, all of which yield (with the exception of the natural fructosides) derivatives containing a six-atom ring.

The same method can be applied to the disaccharides and the polysaccharides, which yield methyl-derivatives, from the study of which it is possible to determine not only the size of their ring-systems, but also the points by which one ring is attached to another in the structure of the more complex compounds. In this way complete structures have been deduced for the *disaccharides*, maltose, cellobiose and lactose, where two six-atom rings are linked through an atom of oxygen, sucrose, where a six-atom glucose ring is linked through oxygen to a five-atom fructose ring, gentiobiose and melibiose, where two six-atom rings are linked through an oxygen atom and a methylene group. In the *trisaccharides*, raffinose and gentianose, a six-atom galactose or glucose ring is linked through $-O.CH_2-$ to a six-atom glucose ring and then through oxygen to a five-atom fructose ring. Finally, the *polysaccharides*, starch and cellulose, which yield glucose on hydrolysis, have been shown to consist of six-atom glucose rings linked together through oxygen, whereas inulin, which is readily hydrolysed to fructose, contains a series of five-atom γ-fructose rings, linked through $-O.CH_2-$.

The introduction of the six-ring into the chemistry of the sugars leads to very interesting stereochemical considerations, since it involves the reappearance of the familiar hexagon, which plays so conspicuous a part in the structure of ice, of graphite, and of the diamond, as well as in the chemistry of aromatic compounds. Although these rings are usually linked together only in chains through $-O-$ or $-O-CH_2-$, it is possible to construct models in which the linking atoms and the atoms of the side chains as well as those of the ring are situated on a hexagonal lattice ; and the existence of such a lattice, as well as some of its dimensions, have now been established by X-ray analysis, especially of ramie fibres.

Prof. Haworth might have written a text-book on the chemistry of the sugars which would have included the pre-War work with which Emil Fischer's name is so largely associated, but this would obviously have been a time-robbing task for one who is fully occupied with original investigations on the subject. Such a book will perhaps be written when the stream of research from the Birmingham laboratory begins to flow less swiftly, and will then form a very welcome contribution to chemical literature ; but, in the meanwhile, the author has taken it for granted that his readers are familiar with the classical work on sugars and has given an authoritative review of the more recent developments, including not only work which has already been published, but also a large amount that is still in the press. The book is therefore not only up-to-date but actually in advance of current literature, and will be a standard work of reference until it becomes out-of-date, mainly as a result of the author's own further researches. T. M. L.

Desert Plants and Water.

(1) *The Plant in Relation to Water: A Study of the Physiological Basis of Drought Resistance.* By Prof. N. A. Maximov. Authorised English translation, edited, with Notes, by Prof. R. H. Yapp. Pp. 451. (London: George Allen and Unwin, Ltd., 1929.) 21*s.* net.

(2) *Die physikalische Komponente der pflanzlichen Transpiration.* Von A. Seybold. (Monographien aus dem Gesamtgebiet der wissenschaftlichen Botanik, Band 2.) Pp. x+214. (Berlin: Julius Springer, 1929.) 26 gold marks.

(3) *Der Wasserhaushalt ägyptischer Wüsten- und Salzpflanzen: vom Standpunkt einer experimentellen und vergleichenden Pflanzengeographie aus.* Von Dr. Otto Stocker. (Botanische Abhandlungen, herausgegeben von Prof. K. Goebel, Heft 13.) Pp. 200. (Jena: Gustav Fischer, 1928.) 12 gold marks.

THE recent appearance of these three monographs is evidence of the very great interest now taken in the water relationships of desert plants, an interest which should be shared by those administratively responsible for arid areas under British control, for the researches summarised in these pages are closely connected with a very important economic problem, that of making the desert "blossom like the rose".

As is apparent from the titles, two of these monographs treat the subject from a more general point of view, and British investigators will think it particularly fitting that the late Prof. R. H. Yapp lived long enough to complete his task of editing this translation of Prof. Maximow's book. Prof. F. E. Weiss contributes a brief biography of the editor, whose footnotes show the deep interest he took in this, his last, completed scientific task; at the same time they bear striking witness to his great fitness for this task and have added very greatly to the value of the book.

The plant of the dry habitat is, by definition, a xerophyte; it has often been assumed to be also xeromorphic, that is, so built that it conserves its water supplies better than does the plant of the normal habitat, the mesophyte. This assumption had little experimental basis and has been challenged with great force and originality by Prof. Maximow, who has had wide experience of the desert regions of south-eastern Europe and of Asia. His criticisms and suggestions have aroused great interest, but many of his earlier writings are very inaccessible outside Russia, and English readers will be very glad to have this translation, which is evidently, in effect, a new book, to which Prof. Maximow has added new sections, whilst Prof. R. H. Yapp added numerous critical and complementary footnotes.

Prof. Maximow has suggested that the primary qualification of the true desert xerophyte is its capacity to survive very considerable water loss. In spite of its 'xeromorphic' appearance and structure, such a plant often loses water freely so long as it is readily available, but when its water content is so diminished in arid conditions that its evaporation is perforce low, it still clings stubbornly to life. The great value of Prof. Maximow's book, however, lies in the wide perspective in which this special problem is regarded. There is a full and critical treatment of the subjects of water absorption, root pressure, transpiration, stomatal control, etc., experimental methods being briefly, but critically, passed in review as well as the general position of our knowledge of these subjects. The book is clearly a 'progress report' on a subject where advance in recent years has been relatively rapid. Prof. Maximow points out that stomatal control is evidently not the only factor at work reducing water loss throughout the afternoon of a sunny day. He gives his reasons for not accepting the 'incipient drying' of the walls as the alternative method of control, and promises a new analysis of the subject, in which it is evident that importance will attach to the water content of the subaerial regions of the plant, as the result of the activities of the root, etc. Evidently we may expect new contributions with fresh experimental data from the Institute of Applied Botany at Leningrad at no distant date.

One particularly valuable feature of this summary of the present position is its full treatment of a mass of original and suggestive Russian work which is very little known in the rest of Europe and in America. In particular, one may cite the full account of the work of Zalenski upon the anatomical differences between leaves at different heights upon the stem, which preceded most modern work upon sun and shade leaves, and of the anatomical studies made by Kolkunov upon the anatomical characteristics of drought resistant plants. To this anatomical section Prof. Yapp contributes some very interesting and lengthy notes based upon work by Yapp and Mason upon the relation of water content to leaf structure, which is as yet unpublished.

(2) Seybold's monograph contains a very temperate criticism of the old teleological point of view as to xeromorphy, but then shows that in

some respects the desert plant may actually be so constructed as to cut down evaporation. The physical problems raised by evaporation from plants are discussed. It is pointed out that the leaf is really a special case of a wet-bulb hygrometer and that leaf temperatures give a definite indication of the progress of evaporation if the method is used under suitable conditions. Many new data are thus obtained as to evaporation from leaves, and it is shown that experiment supports a conclusion reached on physical grounds that the rate of loss of water vapour through the stomata is scarcely affected by wind movement, the diffusion shells determining the rate being within the stoma. In the desert plant, with its thick cuticle, all evaporation is through the stomata and the rate of water loss does not alter in a wind. In the plant of the wet habitat, with thin cuticle, much water is lost through the cuticle; in this case the rate of water loss goes up rapidly in a wind.

Certain structural features of the desert plant, therefore, would seem to deserve, in the light of Seybold's work, the descriptive label 'xeromorphic'; but Dr. Otto Stocker suggests (3) that this term should be dropped, as its implications may not be justified. He suggests that these characteristic structural features should be described as 'ericoid', 'succulent', etc., descriptive terms which do not necessarily imply adaptive values. Dr. Stocker noticed one characteristic of the root systems of the Egyptian desert plants that he studied which must be of great importance to them. He points out that the cells of these roots had osmotic pressures up to 40 and 50 atmospheres, quite as high as he had found in the roots of the plants growing in the physiologically dry habitat of the salt marsh, the characteristic 'halophytes'.

Research on Rheumatic Affections.

Annals of the Pickett-Thomson Research Laboratory. Vol. 4: *The Pathogenic Streptococci; an Historical Survey of their Rôle in Human and Animal Disease.* Part 1: Pp. vii + 250 + 7 plates. Part 2: Pp. viii + 251-494 + plates 8-18. (London: Baillière, Tindall and Cox; Baltimore, Md.: The Williams and Wilkins Co., 1928–1929.) 42*s.* net each Part.

THE six main monographs collected in this volume deal with the rôle of the streptococci in rheumatic fever, in chorea, in erythema nodosum, in carditis, in acute suppurative arthritis, and in chronic arthritis. These monographs give a more or less complete résumé of all the researches of value which have been carried out as to the relationship of the streptococci in the diseases under discussion, but they are not mere records of the experimental results. They contain a great deal of valuable literature on both the clinical and public health aspects—the blood changes in rheumatic fever, the association of tonsillitis with it, its prevalence and danger, its epidemiology and infectivity, etc. The clinical aspects of carditis and the various forms of chronic arthritis are discussed. The treatment of the various conditions by vaccines and sera, and the histological characters of the pathological lesions are carefully reviewed. In fact, the diseases dealt with are treated in an all-round fashion which it would be impossible to find in any other single publication.

The very fact that the bibliography contains more than 1600 references, and that these have been carefully read and the essential parts abstracted, is sufficient evidence of the amount of work involved in compiling these monographs. To the experimental worker on rheumatic affections, to the clinician and to the public health official interested in arthritic diseases, this very exhaustive review of the literature will be of the greatest value. The authors are not content to give the views of others, but in all the monographs there is a discussion of the findings and the conclusions of the authors themselves. This is by no means the least valuable part of the monographs.

Though we cannot agree with all the conclusions drawn by the authors, and though parts of the work will no doubt have to be altered in the light of further researches, yet we feel that this work is an extremely valuable contribution, and we must congratulate the authors on its production.

The photographs by which the volume is illustrated are extremely good, and in themselves form a valuable contribution. Many of these are of colonies grown on Warren Crowe's chocolate agar medium, but we think too much importance has been attached to the appearance of the colonies in an attempt at differentiation. The more one works at bacteriology the more uncertain one becomes of attaching too much importance to variation in shape, size, and general contour of colonies. There seems little doubt that we shall have to revise our classification, and especially our nomenclature, when we realise that one strain of an organism may present different forms of colonies on different media, and especially on complex media such as Crowe's chocolate agar.

It is gratifying to see in the article on "A Simple nd Rapid Test for the Differentiation of Streptoocci" by one of the authors, that he has the ourage to state that fermentation tests are only f third-rate importance as a means of classification nd identification. His test with Lugol's iodine is nteresting, but we do not think sufficient evidence as been given to say that it will be of value in lassification. The value of the test depends on he accuracy of Crowe's medium as a means of diferentiating the types of streptococci, and we are ot convinced of this accuracy. The medium, as ve have already said, is complex, and the streptoocci are organisms whose vitality outside the body s not high. In any colony, or any mass of these rganisms, one will find actively growing members nd dead members, with various stages between the ctive and the dead ones. It seems reasonable to ssume that the action of the organism in these ifferent stages may produce different chemical eactions, or the same chemical reactions in different tages of intensity, and that the colour reaction ith the iodine may appear in different degrees of ntensity, and that therefore an iodine positive and n iodine negative may be the same type of organism n different degrees of activity. We have learned great deal from the work of Andrewes and Cowan bout the rough and smooth forms of streptococci. Ve do not regard them as different types, and we ee less reason to regard an organism which is iodine ositive as a different type from one which is iodine egative.

We are surprised that the author of this test—ven if the test proves to be reliable, and we hope may prove so—should claim that by it Birkaugs *Streptococcus Erysipelatis* has been identified ith Crowe's Al(4) type. Though both are toxin roducers, surely this and the iodine positive eaction are feeble evidence of identification. We egret that this test, of which the author states his xperience has been a short one, should have been nserted. It may be valuable, but its value has et to be proved, and we think it would have een wiser to have established the proof clearly efore including it in a volume of this nature, hich should be in every bacteriological laboratory s a book of reference.

The last monograph deals with Rosenow's hypoesis of elective localisation and its bearing on eumatism, poliomyelitis, encephalitis lethargica, nd dental infection. In the sections of this monoraph, Rosenow's views that mutation in the charters of a given germ occurs in response to its enironment are dealt with very fairly, and the criticism by the author—Dr. Warren Crowe—is very just. We think this monograph will prove of considerable interest, though we cannot say of great value, to those who are not familiar with Rosenow's work. Much as we disagree with Rosenow's conclusions, we think the authors have done well to include this review of his work, and some of the criticisms of that work.

J. M. Beattie.

International Genetics.

Verhandlungen des 5 Internationalen Kongresses für Vererbungswissenschaft, Berlin, 1927. Band I. Pp. viii + 784. Band 2. *Herausgegeben von Hans Nachtsheim.* (*Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Supplementband 2.) Pp. viii + 785 - 1647 + Tafeln 8 - 14. (Leipzig: Gebrüder Borntraeger, 1928.) Bd. 1-2, 100 gold marks.

THE Fifth International Congress of Genetics was held in Berlin in September 1927, and its *Proceedings* have appeared with commendable promptness in two large volumes. The first gathering of this kind was held in London in 1899, before the name of Mendel was known. It was organised by the Royal Horticultural Society and was styled an "International Conference on Hybridization and Plant Breeding". When the next was held in New York in 1902, Mendelism was still too new to have much effect on the proceedings. In 1906 a third conference was held in London under the same auspices as the first, with Bateson as president, and on this occasion he introduced the term genetics for the study of heredity and variation. The fourth conference was held in Paris in 1911, and the fifth was to have taken place at Berlin in 1916. It was 1927 before this congress was finally held, and in the meantime genetics underwent immense developments, as evidenced in part by the contents of these volumes.

Genetics may be said to have transformed the face of modern biology. Its conceptions have permeated much of the best work of systematic botanists and zoologists, while forming the background of all the work in experimental evolution. Even palæontologists have found it necessary to grapple with and incorporate these conceptions in their work, as witness the investigations of Brinkmann on Ammonites, summarised in these *Proceedings*, and the writings of Bather in Great Britain. Only the physiologists have held aloof, despite the fact that Bateson's early reports to the Royal Society were called investigations in the physiology

of heredity, and that Jost's "Plant Physiology" (1907) contained a chapter summarising the contemporary knowledge of heredity and variation from a physiological point of view. Owing to recent developments in genetics the gene is being recognised not merely as a static entity but also as producing its effects dynamically in the ontogeny of the organism. Genetics is thus becoming more physiological, and it is to be expected that physiologists will ultimately recognise that reproduction —the core of genetics—is after all a physiological process.

The 150 papers presented before the Congress, with its six sections and nearly a thousand members, cover such a wide range, representing the many ramifications of modern genetics, that it is impossible here to indicate more than their general scope. The general topics discussed before the whole Congress included the problem of evolution and the modern theory of heredity, by Wettstein of Vienna; polyploidy and species formation, by Rosenberg of Stockholm; chromosome relations in hybrids, by Federley of Helsingfors; the geographic centres of cultivated plants, by Vavilov of Leningrad; genic modification, by Muller; mutable genes, by Demerec; the genetics of *Datura*, by Blakeslee; the organisation and function of an animal breeding research department, by Crew; and the future development of eugenics, by Ploetz. The classic genera *Œnothera* and *Drosophila* were well to the fore, ten Œnotherologists taking part in the conference and seven papers on *Drosophila* being presented. Numerous papers were concerned with cultivated plants, such as wheat, oats, rye, barley, maize, apples, plums, cherries, potatoes, beets, peas, and strawberries; also several on fowls, mice, rats, and one on the tortoiseshell cat.

A number of the papers were primarily cytological, such as that of Miss Blackburn on the chromosomes of *Silene*, Levitsky on *Festuca*, M. Navashin on *Crepis*, Sveshnikova on *Vicia*, Cleland and Gates on *Œnothera*, Tischler on *Ribes* hybrids, de Vilmorin on Solanaceæ, and Vandel on geographic parthenogenesis. Mathematical papers were contributed by Bernstein on the theory of crossing-over, Smirnov on variability, Weinberg on twins and on heredity.

A comparison of these *Proceedings* with those of 1911, when genetics was just getting into its stride, serves to emphasise the many directions which genetic work has taken and the bright possibilities which exist in every one of them for further development. R. R. G.

Our Bookshelf.

Grundzüge der theoretischen Logik. Von Prof. D. Hilbert und W. Ackermann. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 27.) Pp. viii + 120. (Berlin: Julius Springer, 1928.) 7·60 gold marks.

THIS book on theoretical logic is based on the lectures of Hilbert and the work of Bernays and Ackermann. The first chapter summarises the calculus of propositions as deduced from a set of axioms, four of which are the same as those in Whitehead and Russell's "Principia Mathematica". The primitive proposition known as the associative principle was proved by Bernays in 1926 to be deducible from the other axioms and is not included. These axioms are shown to be complete, independent, and free from contradiction. While the fundamental symbols used denote the same ideas as those in the "Principia", the only symbol common to both systems is that for the logical sum, while the sign for equivalence of truth value is almost the same as the sign of negation in the "Principia". One feels inclined to protest against this unnecessary multiplication of notation, which is confusing. A work like the "Principia" should be considered as fixing a standard notation in theoretical logic. Moreover, a further sign (afterwards discarded) is introduced in the second paragraph for "equivalence of meaning"—at best a notion foreign to the calculus of propositions.

The second chapter introduces the propositional function of one variable, and in Chapter iii. the restricted calculus of propositional functions of several variables is discussed. This is likewise developed from a set of axioms due to Bernays, but here the proof of freedom from contradiction begins to encounter difficulties of a more fundamental nature. In the last chapter paradoxes are discussed and their solution by Russell's theory of types. The difficulties arising in the extended calculus are pointed out and suggestions made for avoiding them.

The book is a forerunner of a larger work promised by Hilbert and Bernays on the foundations of mathematics, to which it will prove an interesting introduction. The subject formed the topic of the inaugural lecture given by Hilbert at the Mathematical Congress at Bologna in 1928.

L. M. M.-T.

The Earth: its Origin, History, and Physical Constitution. By Dr. Harold Jeffreys. Second edition. Pp. ix + 346. (Cambridge: At the University Press, 1929.) 20*s*. net.

THE demand for a second edition of this work, after only five years, must give deserved pleasure to the author, and has enabled him to revise and extend it in various directions. The book is increased in length by 68 pages, with a proportionate increase (4*s*.) in price. The principal change concerns the part dealing with seismology; the first

edition (1924) omitted reference to much continental work on this subject, done in the years 1907–1916. Two chapters in place of one are now devoted to seismology, and they are placed earlier in the book.

In this and other sections the conclusions reached on many points are more definite than in the first edition; for example, the age of the earth, formerly estimated as between 1·3 and 8 billion (10^9) years is now limited between 1·3 and 3 billion years; the earth is stated to possess a central core, apparently liquid, with a radius rather more than half that of the earth as a whole, and with a sharp boundary; the bodily tide of the earth is stated to imply that the rigidity of this core is less absolutely than that of the outer shell, and not merely less in proportion to its density. The account of the earth's thermal history has been re-cast, and the discussion of isostasy has been clarified and rendered more precise.

The original appendix C, dealing with the relation of geophysics to geology and geologists, is also expanded, and is expressed in very plain terms; for example, the replies of a well-known geologist to certain criticisms by the author are stated to be "a series of evasions and irrelevancies". Many readers may think that controversies are better conducted in milder terms than these. In general, however, the author's clearness and directness of statement are to be welcomed; one may hesitate to believe that his conclusions are always so certain as his language seems to imply, but definiteness at least affords a stimulus and an opportunity to critics, and arouses discussions which often advance knowledge. There is no doubt, moreover, that the author's synthesis of diverse branches of geophysics has been of great service to the science.

Further editions of this valuable work will certainly be called for; it may be suggested that, in these, the author should extend to all the chapters his commendable practice, at present applied only to some of them, of giving a summary of the main arguments and conclusions in the chapter.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 13, Teil 1: *Die Ionenleitung in Gasen*, von Prof. Dr. E. Schweidler; *Die elektrischen Eigenschaften der Flamme*, von Prof. Dr. A. Becker. Pp. viii + 314. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 29.60 gold marks.

THIS volume deals with two aspects of the conduction of electricity to which comparatively little attention is being paid at the moment. In the first part of the book, Prof. Schweidler summarises concisely the main work which has been done on the general properties of ions produced in gases at relatively high pressures by external agents. The second part, by Prof. Becker, is upon thermally ionised systems. Both subjects still offer a wide field for research, and it is perhaps significant that the most recent measurement of the recombination coefficient (by Dr. Mohler) has been made by a combined electrical and optical investigation in an ionised system at *low* pressure, whilst at the same time the conceptions of mobility and diffusion, which have been developed in connexion with essentially high-pressure phenomena, are being applied with success to the problems of the glow discharge. There has been too great a tendency to keep high-pressure and low-pressure work in separate compartments, and those who are primarily interested in the low-pressure side will find Prof. Schweidler's article extremely useful.

The article on flames furnishes an admirable introduction, from the experimental side, on one hand to the physical basis of the electrical features of flame technology, and on the other to the study of stellar atmospheres.

Theory of Probability. By the late Dr. William Burnside. Pp. xxx + 106. (Cambridge: At the University Press, 1928.) 10*s.* 6*d.* net.

THIS small volume, a posthumous work of Prof. Burnside, is prefaced by a short biography of the author (see also NATURE, Oct. 15, 1927, p. 555) which shows the variety and extent of his contributions to the advancement of mathematics. Apart from his published work, Burnside was responsible for a large amount of confidential matter during the thirty-four years in which he occupied the chair of mathematics at the Royal Naval College.

The book merits attention not only for the precision of its language but also for the careful statement of the rule for calculating calculable probabilities. The usual postulation of equal likelihood does not satisfy Burnside, who points out that a more fundamental postulation is that "each two events are equally likely". A discussion of this point is given in a note at the end. A valuable feature is the application of difference equations and approximate methods of solution to the calculation of probabilities involving large numbers. This book should certainly be read by all interested in the applications of the theory of probability.

L. M. M-T.

The Child of Circumstance: the Mystery of the Unborn. By Dr. Albert Wilson. Pp. xx + 420 + 50 plates. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 15*s.* net.

DR. WILSON gives us of the best of a long and sympathetic experience of human nature and of its derelicts. It is a great boon to have an understanding of the motives behind the criminals' conduct, and this the author has far more than a number of cranks who write with a very narrow knowledge of criminology and how to reform it. This is particularly so when capital punishment is being discussed. The author takes a broad and sensible view of this and thinks that if the lethal chamber replaced the rope it would be an advance in treatment. At the same time, he points out that when the death penalty is abolished, juries are more ready to convict—perhaps on less certain grounds. Unlike many who write on the subject, he recognises the viewpoint of the murdered one's relatives.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Oyster-drills on English Oyster-beds.

THE occurrence of the American oyster-drill, *Urosalpinx cinerea* Say, on oyster beds in the River Blackwater, Essex, was recorded in NATURE (Aug. 18, 1928, p. 241), and has since been found to be present in great numbers on the shallower parts of these beds in summer-time. This pest, which was first confused with the rough tingle, *Ocinebra erinacea* (= *Murex*), has thus become acclimatised, like its congener, the American slipper-limpet, *Crepidula fornicata*, since its introduction from America, and unless care be taken may spread to other oyster-beds. There now occur in England three oyster-drills or tingles, which in the adult state bore holes through the shells of oysters—and other organisms—and devour the body of the prey through the hole made in the shell, namely :

Urosalpinx cinerea, the American oyster-drill, or rough-tingle,
Ocinebra erinacea, the European rough-tingle, and
Purpura lapillus, the European smooth-tingle, or dog whelk.

These three snail-like tingles are shown together in Fig. 1 ; and by isolating living samples of the different kinds in the tanks at Plymouth, before the spawning

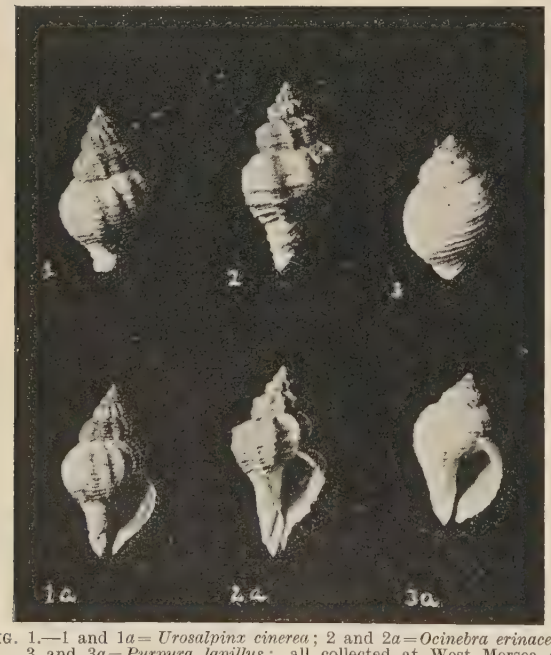


FIG. 1.—1 and 1*a* = *Urosalpinx cinerea*; 2 and 2*a* = *Ocinebra erinacea*; 3 and 3*a* = *Purpura lapillus*; all collected at West Mersea on Oct. 25, 1928. (Touched-up photographs about two-thirds the natural size.)

period in spring, their egg-capsules have eventually been obtained, and are shown in Fig. 2.

In each species, individuals lay a variable number of egg-capsules and also tend to congregate to spawn, so that large numbers of capsules may be found in clumps. The egg-capsules of each kind can, however, be easily distinguished by their characteristic shapes, as shown in 1, 2, and 3 of Fig. 2. The capsules of *Ocinebra* (2, 4, and 5 of Fig. 2) from the three different localities are not of the same size ; this difference is, however, correlated with the size of the adults. In transverse section, the appearance of the egg-case of *Urosalpinx* is oval (1*a*) ; that of *Ocinebra* is triangular (2*a*) ; and that of *Purpura* is nearly circular (3*a*). The

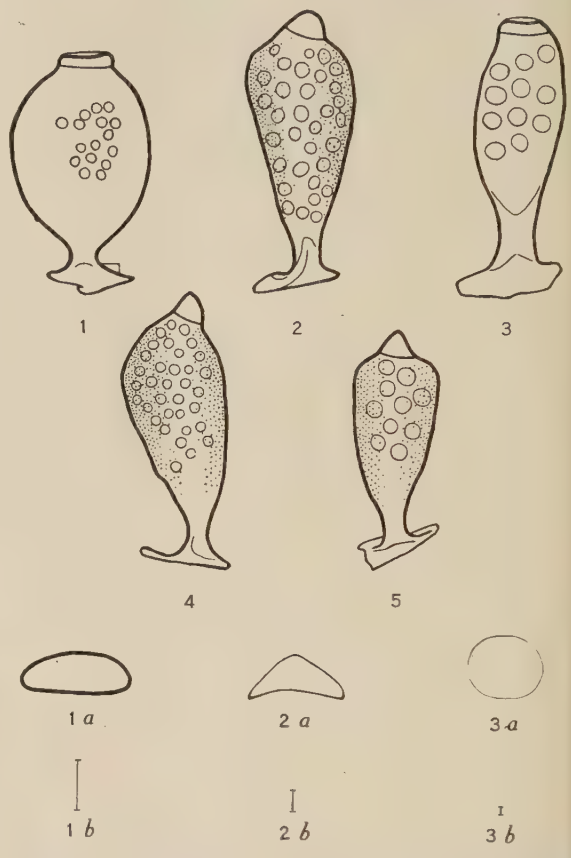


FIG. 2.—1, 2, and 3, egg-capsules of *Urosalpinx cinerea*, *Ocinebra erinacea* (= *Murex*), and *Purpura lapillus* respectively, from West Mersea, with developing embryos; 4 and 5, egg-capsules of *O. erinacea* from Falmouth and Plymouth with embryos. 1*a*, 2*a*, and 3*a* are transverse sections of the capsules of *Urosalpinx*, *Ocinebra*, and *Purpura*. (All the drawings are made to the same scale.) 1*b*, 2*b*, and 3*b* represent diagrammatically the relative thickness of the capsules of the three forms.

wall of the capsules of *Urosalpinx* and *Purpura* is uniformly thickened, whereas that of *Ocinebra* is thicker at the two ridges than in the rest of the case (2*a*). Sections at various levels of the egg-capsules show no difference in thickness of the wall. From the illustrations of the transverse sections, it will be observed that the wall of the capsule of *Urosalpinx* is thicker than that of *Ocinebra*, which in turn is thicker than that of *Purpura*. The relative thickness is as 7 : 3 : 1, and is demonstrated in the vertical lines 1*b*, 2*b*, and 3*b*; actual measurements are approximately 70 μ, 30 μ, and 10 μ.

The number of embryos in the capsules, as shown in 1, 2, and 3 (Fig. 2), differ greatly. These differences may, however, be specific, or due to age, or to the artificial conditions under which the eggs were laid. In the capsules of *Purpura* (3) and *Ocinebra* (5) there are fewer—but older—embryos than in those of the other specimens, but it is known that in *Purpura* the greater number of eggs is absorbed to provide nutriment to a few surviving embryos (Pelseneer, in

'Treatise of Zoology", vol. 5, Mollusca, p. 21, edited by Sir E. Ray Lankester), and it is probable that the same phenomenon holds good for *Ocinebra*.

It will be interesting to follow the distribution of the American drill in the future, but as the young individuals of this species do not pass through a free-swimming larval stage, unlike *Crepidula*, their dissemination is likely to be very slow. Fresh introductions may, however, be made at any time on American oysters imported on beds in or outside the Thames Estuary area, so that the illustrations given above may help either in preventing the spread—or a fresh introduction—of such a pest, as may indeed render unprofitable the work of experienced oyster-cultivators (see NATURE, **120**, 653; 1927).

J. H. ORTON.
C. AMIRTHALINGAM.

Marine Biological Laboratory,
Plymouth, July 22.

Growth-gradients and the Axial Relations of the Animal Body.

PROF. HUXLEY'S letter in NATURE of June 15 raises a very interesting feature of animal organisation which I have myself been studying recently. Briefly, in certain aspects of the growth of Crustacea there are gradients which do not decline uniformly and simply from front to rear in the manner originally put forward by Child for certain worms ("Growth and Senescence", 1915: "Individuality in the Animal Kingdom", 1916), but present a multiplicity with one or more peaks at points of great differential growth, the maximum lying at the level of the chelæ in males or in the abdomen at certain stages of female *Carcinus*.

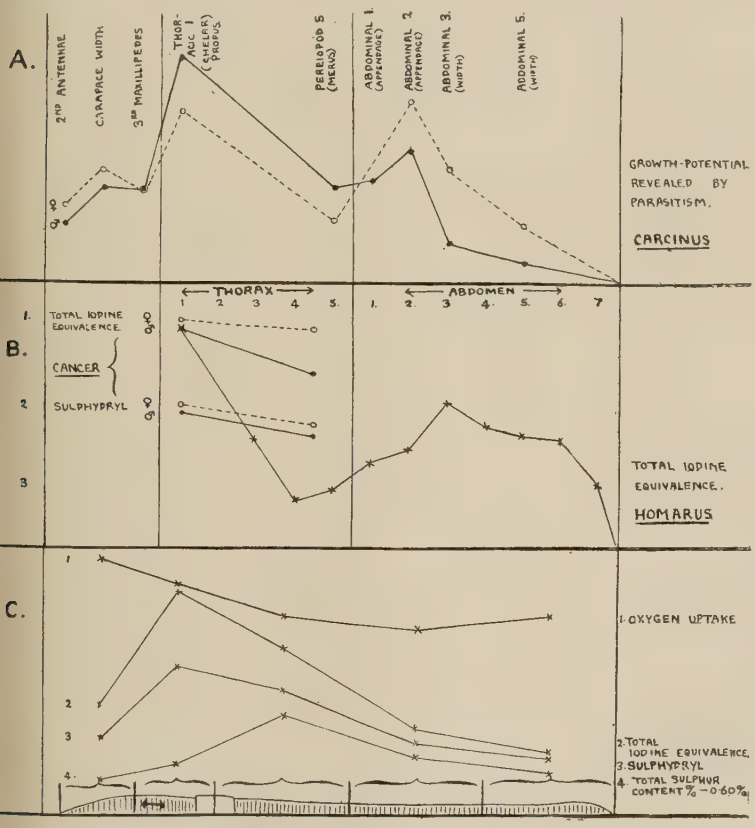


FIG. 1.

Analysis of the conditions in *Carcinus* of both sexes at different ages and when parasitised by *Sacculina* has suggested that relations between different parts of the body depend upon two considerations:

(*a*) The existence of varying degrees of differential or dysharmonious growth in which each structure exhibits a characteristic 'differential growth ratio' (Huxley, 1924), which may, however, change with uniform exponential acceleration or decrement over more than a whole year, and is not quite alike on the two sides.

(*b*) The competitive effect of great growth in the chelæ, etc., at certain times, which restrains the simultaneous growth at other less rapidly growing points even if they exhibit a similar tendency to increasing growth. Precisely analogous conditions have been demonstrated by Champy in Amphibia ("Sexualite et Hormones", 1924).

The effect of the parasite is to eliminate the increasing acceleration of one part over another part chiefly by reducing the 'differential growth ratio', and from relief of the restraint imposed by rapidly growing structures like the chelæ a relative increase results in the slowest parts, which is very obvious in the abdomen of males though perhaps most typical in the antennæ of both sexes. By comparison of the actual measurements with a chart prepared to show different rates of relatively accelerating growth under the competitive restraint of the most rapid, it has been possible to deduce the inherent rate of growth of other parts as compared with the chelæ uncomplicated by the effects of competition, thus using the parasite to perform a physiological experiment which could not be procured by any surgical means.

The gradient thus revealed by the parasite is typical of a long series of anatomical relations which have been found in *Carcinus* of 15-60 mm. carapace-length, that is from one to three years old, which include:

(1) The proportional size of structures expressed as a percentage of the carapace-length at any age.

(2) The percentage increase in size of structures for 100 per cent increase of carapace-length between any two ages.

(3) k in Huxley's heterogonic formula (NATURE, **114**, 895; 1924)

$$\text{Structure-size} = b \times (\text{Body-size})^k$$

obtained from the slope of a log log plot of the structure against carapace-length.

(4) The exponential rate of change of k between 25 mm. and 50 mm. carapace-length.

(5) The range of variation of different structures expressed as a percentage of the size of the part concerned.

(6) The proportion (percentage) of individuals which exhibit asymmetric development at the various levels.

(7) The proportion of asymmetric individuals which are right-handed at the different levels (autotomy and variation allowed for), or the bias of symmetry given by the formula

$$R - \frac{L+R}{2} = B,$$

where B is the amount of bias to right (+) or left (−), R and L the number in 100 crabs which are right or left handed, taking care to note the incidence of autotomy on one side or the other and to deduct an appropriate percentage the condition of which was probably due to this extraneous cause.

(8) The inherent growth-potential revealed by the effects of the parasite *Sacculina* (Fig. 1, *A*).

All these gradients are so very similar as to warrant the conclusion that their forms depend upon the same system. The last (8) is published here as a typical example, and it will be noticed that it corresponds closely with the gradients for relative size (*Inachus*) and percentage increase with 100 per cent carapace increase (*Palæmon*) published in Prof. Huxley's letter.

Perhaps the most remarkable feature of these complicated gradients is their general correspondence with a gradient of extractible reduced 'glutathione' or sulphydryl and other reducing compounds titratable with iodine, which unfortunately cannot for lack of tissue be demonstrated outside the thorax of crabs but has been found more completely in the lobster (Fig. 1, *B*). In earthworms (Fig. 1, *C*), I find that the gradient of growth corresponds with the gradients of total iodine equivalence (*C*, 2), extractible sulphydryl (*C*, 3), and total sulphur (gravimetric) (*C*, 4), and not with the gradient of total metabolism (*C*, 1) observed by the oxygen uptake; the last, therefore, includes other oxidation systems which it is legitimate to suppose result in katabolism rather than the anabolism of growth. It is interesting to find that gradients in the earthworm have a summit at about that point whence a divided worm grows forwards or backwards according to the aspect of the cut surface.

I find that the diminution in sulphydryl effected by *Sacculina* (NATURE, **120**, 654; 1927) is more fundamental than any other chemical change yet investigated, and along with the total iodine equivalence it is more closely associated with changes in external anatomy than are other chemical features.

The well-known decline of metabolism with age, corresponding to the decline from front to rear in planarians, is an important element in Child's system of animal organisation and gradients. Similarly, I have found a decline of extractible sulphydryl or iodine equivalence with advancing age in *Carcinus*, *Pandalus*, the embryos of *Sacculina*, and in the cockroach (*B. orientalis*). In the last form, adult females were found to be closely similar to the old larvæ, the external anatomy of which is almost identical, whilst the males presented a further advance.

Champy (l.c.) has made an elaborate study of the interrelationship of the growth of parts according to maturity, season, and nutrition in newts. I found that in these animals points of relatively rapid growth were characterised by high iodine equivalence, and that there was a close correspondence in all its features with the system worked out by Champy.

There is an attractive feature of the 'glutathione' system which might be held to explain the setting-up of gradients. An important part of the sulphydryl is rigidly attached to protein from which it cannot be washed free; it is also found that proteins will take up sulphydryl from solutions of 'thiol' compounds (vide "Glutathione" by H. E. Tunnicliffe, *Biol. Reviews, Camb. Phil. Soc.*, **2**, pp. 84-86). It may be supposed that when new protoplasm is laid down, the sulphydryl content of its protein (which would afterwards control the total content in equilibrium) is determined by the concentration of free sulphydryl in the fluid bathing its situation of origin, and since that is a portion only of the total parental content, it follows that a gradient might be set up. Autolysis of tissue accompanying abrupt larval metamorphoses might result in the development of new growing points with new gradients connected to their fellows by transitional gradients necessitated by the processes of diffusion. The decline with age would result from the preponderating accumulation of daughter protoplasm of lower value.

These observations were made in the course of an extended study of the effects of *Sacculina* on *Carcinus* made at Cambridge in the Sir William Dunn Institute and in the Zoological Laboratory, the details of which will be published in due course.

MICHAEL PERKINS.

5 Little Cloisters,
Westminster Abbey, S.W.1,
July 8.

Fine Structure of Infra-Red Absorption in Organic Compounds and the Raman Effect.

THE infra-red absorption bands of nine organic liquids have been studied in the 3·5 μ region. The spectrometer employed made use of an eschelette grating, which had a resolving power of 10,000 as compared with approximately 170 for a 3-inch rock-salt prism in this region. The dispersion was such that, with the slits 0·25 mm. wide, one slit width contained a portion of the spectrum only 25 A. wide. The wave-lengths as given below are believed to be accurate to $\pm 0{\cdot}003\,\mu$.

The compounds thus far studied are as follows: benzene, toluene, ortho-, meta-, and para-xylene, ethyl benzene, butyl benzene, monochlor benzene, and monobrom benzene. This group of benzene derivatives furnishes us with an excellent opportunity for the study of the effect of the various substitutions on the vibrations of the benzene radical. In most cases, just as would be expected, the effect was to shift the absorption bands towards longer wave-lengths. The magnitude of the shift, however, was surprisingly small, being less than 0·01 μ in every case.

The absorption band in benzene usually reported at 3·25 μ was found to consist in reality of three component parts, namely: 3·231 μ, 3·253 μ, and 3·291 μ, each being of approximately the same intensity. Bordering these, several weaker bands were also found.

In the case of toluene, the substitution of the CH_3 group shifted each of the benzene bands towards longer wave-lengths by 0·007 μ. The bands at 3·238 μ and 3·261 μ suffered a marked decrease in intensity, while the band at 3·298 μ remained strong. Other bands were found at 3·278 μ, 3·343 μ, 3·428 μ, 3·478 μ, and 3·481 μ, which are probably due to the CH_3 radical. The combined effect of the introduction of these new bands and the above-mentioned intensity changes would appear under low resolution simply as a shift of the benzene band from 3·25 μ to approximately 3·35 μ. Coblentz finds this band in toluene at 3·34 μ.

The three isomeric forms of xylene show very interesting results. In orthoxylene, in which the two CH_3 groups are nearest together, rendering the molecule very unsymmetrical, only one benzene vibration is possible, and it has been shifted by 0·007 μ. In metaxylene the two CH_3 groups are somewhat separated, having replaced two alternate hydrogen atoms in the benzene radical. Here the 3·291 μ band occurs without having suffered a shift, while the other two are absent. However, in paraxylene, the CH_3 groups replace two diametrically opposite hydrogen atoms, and therefore the molecule is still symmetrical, just as in the case of pure benzene. We would expect the

effect here to be very small. In fact the 3·231 μ and 3·291 μ bands each occur just as in benzene except for a slight decrease in intensity. The 3·253 μ band is entirely absent.

In each of the xylenes, a group of strong complex bands, apparently due to the two CH_3 radicals, occurs in the region from 3·3 μ to 3·5 μ. The exact locations of some of these bands vary slightly for the three forms. Coblentz gives a single band, the same for each form, the wave-length of which is 3·38 μ, while several other observers give 3·39 μ.

Similar results were obtained for the other four compounds. In some cases all of the benzene bands were present and shifted, while in others only intensity changes were noted. In still others, some of the benzene bands were entirely missing. In no case was a shift found which could possibly exceed 0·01 μ.

This work was undertaken for the purpose of obtaining a correlation between the infra-red absorption spectra and the Raman spectra for various liquids. Using the Raman photographs taken by Prof. R. W. Wood (*Phil. Mag.*, vol. 7, No. 45, p. 858; 1929) an excellent qualitative agreement was found in every case. That is to say, for each Raman line an infra-red band was found which very closely checked it in regard to frequency. However, many infra-red bands were found which apparently were not predicted by the Raman photographs. Where, for example, the latter might give four lines, some 15 or 20 infra-red bands were found. Since the detail shown by the infra-red measurements far exceeded that by the Raman plates, an exact check of the two sets of wave-lengths was not possible. It is hoped that a full account of this work will be ready for publication at an early date.

R. B. BARNES.

Johns Hopkins University,
Baltimore, Md.

Liquid-Solid Interface Tension.

THE convex meniscus of mercury can be explained by assuming a state of tension in the limiting layer of this liquid, not only at the free surface, but also at the area of contact with the containing vessel. But while free surface tension has ceased to be a hypothesis, the reality of a liquid-solid interface tension has not been proved. The following experiments are intended to fill this gap.

(*a*) A 'liquid pincushion'. The experiment succeeds best with a fine steel wire, 2½ cm. long and weighing about 10 mgm., both ends of which are rounded, but the finest sewing needle in the market supplied head downwards, although somewhat stouter, may be used instead. A small, concave porcelain dish is filled with mercury to the depth of a little more than 1 cm. The wire, introduced into the mercury and then released, is of course rejected, but the moment its end touches the solid bottom it loses its buoyancy and adheres to the smooth surface of the porcelain. Quite a number of wires or, with a little care, needles can be fixed upright in this manner, producing the effect of a liquid pincushion bristling with needles.

This peculiar phenomenon admits of one interpretation only. The interface layer of mercury which surrounds the submerged part of the wire, and that which clothes the surface of the porcelain, must both be assumed to be in a state of tension. When the steel touches the porcelain, the two layers become united and forthwith contract into the smallest possible area. The result is a withdrawal of the liquid from the capillary space between the rounded end of the wire and the porcelain. The mechanical effect of this withdrawal is twofold:

(1) As there is no more mercury beneath the terminal surface of the wire, the liquid pressure acts on it horizontally only, and there is no more upward lift.

(2) The capillary space just mentioned has been converted into a diminutive vacuum towards which the surrounding mercury turns a *free surface*. It is the tension of this circular zone of free surface which pins the end of the wire to the smooth surface of the vessel and holds it there.

(*b*) The Gibbs-Thomson principle. One of the manifestations of this principle is the concentration (W. Ramsden, *Transactions of the Liverpool Biological Society*, vol. 33, 1919) of a solute in the surface layers of its solution. In extreme cases, saponin and albumin solutions for example, the surface layers solidify and can be separated from the solution in the form of a solid membrane. It is characteristic of all such solutes that they lower the surface tension of the solution. In the light of this knowledge the following observation is of theoretical interest.

A watchglass is filled with mercury, and a small quantity of zinc, or of the less soluble copper, is dissolved in the liquid. Very soon the surface loses its lustre, and a soft but solid film is formed all over it. This film, which is a mercurial alloy, is thick and gray in the case of zinc, thin and of a golden brown if copper is used. If it is brushed away, it rapidly forms afresh.

This solid film covers not only the free surface but also the interface, into which it is continued without a break. Seen from below through the glass, the interface film has the same appearance as the surface film. Consequently, if the latter owes its existence to the working of the Gibbs-Thomson principle, then it may be taken as extremely probable that the interface film has the same origin; in other words, that the interfacial layer of mercury is the seat of a considerable store of potential energy and of tension.

MAX LOEWENTHAL.

160 Princes Road,
Liverpool,
July 11.

Coal Reserves of China.

IN the leading article "Coal, Iron, and World Peace," of NATURE (Aug. 3), the coal reserves of China were discussed. The amount was taken as 23,000 million tons from the cautious calculation of Dr. W. H. Wong. This numerical value seems to be not quite correct.

Only a few months ago, in a private communication, Dr. Wong informed me that recent investigation by him and his colleagues has put 302,000 million tons as the total coal reserves of China. This is nearly one-third of Drake's estimate; and eight times Inouye's. Drake over-estimated the coal reserves of Shansi, the most important coalfield of China, as 714,000 million tons; Chinese investigators now give a round number of 127,115 million tons only. The coal reserve of Manchuria now estimated as 2950 million tons, was under-estimated as 1209 million tons by the older workers. They also neglected not less than 1000 million tons of coal in the provinces known as Inner Mongolia. The lignite reserves of North Manchuria and of Szechwan are not known definitely even at present.

If we draw a line with its origin at Peiping (Peking) extending both north-eastward to Harbin and south-westward to Chungking of Szechwan, then within a

few hundred miles along both sides of this line there are rich coal fields and other mineral resources on which 'the mechanised form of civilisation' of young China will be based.

Although I quite admit, and I have repeatedly warned my fellow-countrymen, that there is a deficiency of mineral resources in China, it is still possible for the western Pacific to play an important part both in the mechanised civilisation and in the world peace. Not with 'Oriental exaggeration', but with Sir Thomas Holland's brilliant presidential address, I would believe that the mineral wealth of China, if not counted as per head, but per "homogeneous national unit", is only next to that of the British Empire and that of the United States; and China is sufficiently qualified to be one of the few peace-keepers of the world provided her resources can be developed by her own energy. The awakened Chinese know their debt to the new civilisation.

K. H. LIH.

6 Denbigh Road,
London, W.11.

MR. LIH'S letter provides early confirmation of the expectation expressed in the article that further investigations would lead to the increase in the estimated coal reserves of China. The new estimate by Dr. Wong, as reported by Mr. Lih, is an increase of more than thirteen times from that quoted in our article from the "China Yearbook", p. 124, 1924, and apparently it does not include all the Chinese areas in which coal is known to occur. Even if the estimates are not further raised, 300,000 million tons is a useful lot of coal.

THE WRITER OF THE ARTICLE.

Courtship Displays of Birds.

IN his theory to account for the occurrence of 'mutual' and 'dimorphic' courtship displays in birds, Prof. J. S. Huxley states that "in birds in which the sexes are quite or almost similar, and both adorned with bright colours or special plumes or other structures, which are displayed or otherwise used in sexual ceremonies, both sexes play a quite or nearly similar rôle in 'courtship'" (*Jour. Linn. Soc.* (Zool.), **35**, p. 253; 1923). Conversely, a dimorphic courtship is found where no such epigamic characters are developed, or where the sexes differ in structure or coloration.

In view of this, it seemed likely that the courtship of the sheldrake (*Tadorna tadorna*) would be an interesting test-case; for, on one hand, this species is closely related to the ducks, where courtship is predominantly a male display, the female being usually more soberly coloured; and, on the other, the male and female sheldrake differ from the true surface-feeding ducks in being almost exactly alike, and as brightly coloured as any bird in England. For this reason, Kirkman ("British Bird Book", vol. 4, p. 216; 1913) was led to predict a mutual type of courtship.

I was able to make a series of observations in 1928 and again this spring, and found the usual courtship typical of the ducks; that is, the preliminary display is made by the male, and consists of bowing movements with several variants. The female's active part is only informative, restricted to the adoption of the pairing attitude. But in addition to this, on a very few occasions, both birds dipped their scarlet beaks into the water repeatedly, the female straightening out into the pairing position as she did so. Pairing followed this in two cases. Again, on two occasions, both birds made two or three short dives together *after* pairing, when normally they preened and flapped their wings like other ducks. These were the only actions observed which could be called 'mutual', and together occupied but a few minutes out of some fifty hours watching. The sheldrake cannot therefore be placed in the same category as the grebes, egrets, gannet, etc. It may be added that the wetting of the beak is found in other duck-courtships.

There are exceptions to the theory among the passerine birds also. Perhaps the conspicuous black of the rook is not to be considered as a bright colour, but I have seen a redbreast, which would certainly fall into Prof. Huxley's 'mutual' class, parade before its mate in the same way that the house-sparrow and chaffinch do. It seems premature to generalise about so complex a subject, for it is at least possible that the general form of the courtship of a group of birds antedates the development of specific epigamic coloration in evolution.

V. C. WYNNE-EDWARDS.

Marine Biological Laboratory,
Plymouth, July 22.

Growth and Longevity of Whales.

IN his letter to NATURE of June 15, p. 910, Mr. Gray suggests that there is evidence that the Greenland whale grows and multiplies slowly, and attains a considerable age, and he contrasts this with the conclusion mentioned in my paper at the British Association, 1928, that blue and fin whales reach sexual maturity in a comparatively short period. He refers (1) to the length of the Greenland whale and its whalebone at different stages of the whale's growth, (2) to the absence of any sign of increase in the numbers of this species, and (3) to the finding of old harpoons in Greenland whales.

1. It is not explained on what evidence the lengths of the Greenland whale at birth, weaning, and sexual maturity are arrived at, and even if the figures mentioned are accurate, it does not necessarily follow that maturity is reached only after a comparatively long period. The growth of the whalebone should be considered with caution in this connexion, for there is evidence that it undergoes a sudden increase in length immediately after weaning.

2. It is true that the early attainment of sexual maturity would favour comparatively rapid increase or replenishment of numbers, but we have to set off against this the very slow rate of reproduction; for a female, at least in the case of blue and fin whales, normally gives birth at intervals of not less than two years, and, except on very rare occasions, brings forth only one young at a time.

3. In view of Mr. Gray's evidence from the finding of old harpoons, it is difficult to avoid the conclusion that the Greenland whale may reach an age of forty years or more. It is possible that this species attains to a greater age than the rorquals, but I do not in any case think it impossible that, say, a blue whale might live to an age approaching forty years, though it seems probable that the majority of those killed in the sub-Antarctic are very much younger than this.

I should perhaps mention that the question of the growth and age of blue and fin whales is discussed in detail in a paper, now in the press, by Mr. J. F. G. Wheeler and myself, dealing with part of the Discovery Investigations.

N. A. MACKINTOSH.

c/o The Secretary,
Discovery Committee,
Colonial Office,
London, S.W.1.

Phototropy in Inorganic Compounds.

So far no coherent or consistent explanation of the phenomenon of phototropy has been given, although numerous compounds which manifest this property have been studied. A study of the phototropy of dithiotrimercuric salts of the general formula $HgS.HgX_2$ or $2HgS.HgX$, according as X is the negative ion of a monobasic or a dibasic acid, has revealed the interesting result that the phototropy in these compounds is due to the decomposition of the compound by the absorption of actinic energy, forming mercuric sulphide and the other mercuric compound, and hence the compounds blacken in sunlight. When preserved in the dark, they again recombine with the emission of radiant energy, giving the original compound.

The ease and facility with which the direct combination takes place in the dark depends in large measure on the fine state of division in which the constituents separate themselves on exposure of the original compound to direct sunlight, and even microscopic examination of the exposed phototropic substance fails to reveal its heterogeneous character. Further confirmation for this explanation has been found in the fact that when the constituents are obtained in a fine state of division either by intimate grinding or by rapid precipitation, and then mixed in proportions determined by the general formula and boiled with water, the compound is formed.

The phototropic substance, as has been stated, represents a molecular mixture of two simpler constituents. If one of the two constituents can be removed by an inert solvent, the residue should no longer manifest the phenomenon of phototropy. This is fully borne out in the case of dithiotrimercuric salts. Thus in the case of dithiotrimercuric halides, the salts are suspended in water and exposed to sunlight with frequent shaking to ensure complete exposure and darkening of the whole salt. The chloride or bromide being soluble can be removed by water and, in the case of the iodide, a dilute solution of potassium iodide is employed. The residue is no longer phototropic and consists of mercuric sulphide.

This mixture theory of phototropy is being examined in the case of other phototropic inorganic compounds which have been recorded.

E. LAKSHMINADHA RAO.
K. VARAHALU.
M. V. NARASIMHASWAMI.

Research Laboratories,
Maharajah's College,
Vizianagaram, S. India,
July 2.

Rotation of the Earth and Magnetostriction.

IN NATURE of Jan. 5, 1929, p. 15, there appeared a letter from Prof. Edward S. King on a possible relation between changes in the rate of the earth's rotation and changes in the magnetic declination. Prof. E. W. Brown (*Trans. Ast. Obs.*, Yale University, vol. 3, part 6) is quoted as having shown that changes more or less abrupt occurred in the former quantity about 1785, 1850, 1898, and 1918.

As to magnetic conditions in recent years, it is probable that the observations of Eskdalemuir Observatory, for which hourly values are computed and published, constitute, over the period 1912–27, a homogeneous series from which annual mean values of declination and of at least the horizontal component of magnetic force may be derived with considerable accuracy. It is therefore of great interest to discover that an abrupt change in the rate of decrease of H occurred about 1918 and an abrupt change in the rate of decrease of D about 1920. From 1912 to 1918 the annual rate of decrease of H averaged and never differed greatly from 22γ ($1\gamma = 10^{-5}$ C.G.S. units); from 1919 to 1927 it averaged 10γ. From 1912 to 1920 the rate of decrease of D averaged and never differed greatly from 9·3′; from 1921 to 1927 it similarly averaged 12·4′.

As Prof. King remarks, the whole question is of great interest; like him, I have written this note in the hope that others, acquainted with special aspects of the problem, may pass their judgment.

A. H. R. GOLDIE.

Edinburgh, July 10.

Band Spectrum of Magnesium Oxide.

CH. M. OLMSTED noticed that magnesium oxide gives out a band spectrum consisting of several groups of bands (Diss. Bonn; 1906; *Z. f. Wiss. Ph.*, **4**, 255; 1906). He classified them into three groups: the first group consisting of bands from λ4900 downwards degrading towards violet; the second group was in the region λ4286 to λ4771; the third group was below λ3980, consisting of bands partly degrading towards violet and partly towards red. He classified them in an empirical series.

We have recently studied the band spectrum of magnesium oxide with a Hilger E_1 quartz spectrograph. There are eight distinct groups of bands extending from λ4372 to λ5700. The 61 band heads have been arranged in the usual n', n'' progression, and the $\Delta\nu'$ and $\Delta\nu''$ values of the bands can be well represented by a third degree equation using the least square method developed by Birge and Shea (*Univ. Calif. Pub.*, vol. 2, p. 67, etc.).

The vibrational constants of the molecule have been found to be as follows:

$\omega_0' = 817{\cdot}01$ cm.$^{-1}$ $\qquad$ $\omega_0'' = 773{\cdot}85$ cm.$^{-1}$
$\omega_0'x' = 2{\cdot}378$ cm.$^{-1}$ $\qquad$ $\omega_0''x'' = 2{\cdot}86$ cm.$^{-1}$

The intensities of the heads have been examined by a Moll microphotometer, and the nature of progression and the intensity relation indicate that the molecule is of the normal type having small change in the moment of inertia. The O-sequence has only four bands the intensities of which rapidly fade away, and both the +1 and the +2 sequences contain a number of bands overlapping to a large extent. A detailed investigation is in progress in this region, and also in the other regions of the spectrum, regarding the character of these bands, and results will be published elsewhere.

P. N. GHOSH.
B. C. MOOKERJEE.
P. C. MAHANTI.

Applied Physics Department,
University College of Science, Calcutta,
June 19.

Spectrum of Trebly Ionised Argon.

WITH the aid of the extension of the irregular doublet law described by Drs. Saha and Kichlu, and the method of horizontal comparison, I have been able to effect a classification of the lines of trebly ionised argon from the data given by L. and E. Bloch (*Ann. de Physique*, 1926). All the quartet multiplets due to the transition $2M_2(N_2 \leftarrow N_1)$ have been obtained. $\Delta P_{23} = 645$, $\Delta P_{12} = 590$. $4S_2 - {}^4P_3 = \nu 42804$, and $4P_3 - {}^4\bar{P}_3 = \nu 40560$. $4P_3 - 4D_4 = 36789$.

D. S. JOG.

Physics Department,
University, Allahabad, June 16.

Agriculture and the Empire.[1]

By Sir ROBERT B. GREIG.

A PAN-AFRICAN Congress of Agriculture is meeting side by side with the Agriculture Section of the British Association, which is an Imperial body for the advancement of science. The Imperial aspect of agriculture is surely therefore a subject for consideration and discussion. Because the Empire includes so many diverse peoples differing in physical and mental attributes, and because it yields such a variety of natural products, it offers problems political, social, and industrial, of peculiar interest and complexity. Moreover, its political structure is of peculiar advantage. The free nations of the Commonwealth, along with the great non-self-governing territories, can meet without difficulty or embarrassment for the discussion of common problems. They have a focal point or centre in England from which concerted action may, if desired, be taken.

Citizenship of the Empire involves responsibilities. The governments are trustees for rich territories and for hundreds of millions of native populations. These native populations can rise in the scale of civilisation only according as they may be influenced by education, sanitation, law and order. In our colonial Empire in the past we have concentrated chiefly upon administration and we have reason to be proud of the results. But the native populations will judge us in the future not by the excellence of our administration but by the means we take to help them to a higher standard of living and to secure for them some of the benefits of civilisation.

The progress of civilisation depends upon science, not science stated crudely as chemistry or botany, but the scientific spirit applied to all aspects of life. If science is applied to the economics of the Empire, the greatest economic asset to which it can be applied is agriculture. The true wealth of the world, the wealth which determines the standard of living of nations, is limited by the capacity to produce cereals, milk, meat, wool, cotton, hides, and other prime necessities of life of soil origin. Agriculture is also the one great permanent industry, the one which is the foundation of all national or indeed of world wealth.

THE EXTENT OF EMPIRE AGRICULTURE.

The British Dominions, India, and the Colonies cover 24 per cent, or nearly one-quarter of the globe, and they contain 24 per cent, or nearly one-quarter of the world's population. Of this immense area no precise measure of the full extent of land in agricultural use is available, but the proportion is small. The most intensively cultivated of the larger areas is India, the least intensively cultivated is Australia. In the aggregate only 8·7 per cent of the total land surface of Canada, India, the Union of South Africa, Australia, and New Zealand is under arable cultivation. It is difficult to obtain figures indicative of the possibilities of the tropical and subtropical territories, but the African possessions alone are capable of enormously increased production.

In the nine provinces of Canada the 'possible farmland' is 358 million acres, or about one-quarter of the total land area of the provinces, and five and a half times the present total of both arable and pasture. In India, the most intensively cultivated, it is estimated that the cultivable waste land is equal to half the present cultivated area, or about 153 million acres.

Some evidence of the importance of the grasslands of the Empire is obtainable from the numbers of the world's live stock. Of every hundred head of cattle in the world, forty-four graze on Empire pastures, and of every hundred sheep, thirty-eight are in the Empire.

It is easy to realise the importance of agriculture in Canada or Australia, but in an industrial and mineral country such as Great Britain and in a great mineral-producing country such as South Africa, the place of agriculture is apt to be overlooked. In the three larger Dominions and even in Great Britain, agricultural production is more valuable than mineral production. It may be astonishing to some to learn that Great Britain, including Northern Ireland, produces more agricultural wealth than Australia and four times as much as South Africa. When the value of minerals is combined with the value of manufactures, even then the agriculture of Canada and Australia is more important than minerals and manufactures combined.

The distribution of the population dependent upon agriculture is best shown by such countries as South Africa, India, and Nigeria. In South Africa, in spite of its small agricultural and great mineral production, 37 per cent of the population are engaged in agriculture and only 5 per cent in mining. In India 72 per cent are dependent upon agriculture, and in Nigeria (which is three times the size of Great Britain and one-third of the size of British India) practically the whole population depends on agriculture.

It is obvious that a vast area of the Empire is capable of further production, even if developed only on the present lines with the application of existing knowledge. But if we apply not only the science now at our disposal but also the results of further investigations which are sure to follow, the potentialities become almost incredible.

RELATION OF SCIENCE TO AGRICULTURE.

Agriculture can be regarded as the application of all the sciences to the exploitation of the soil. There is scarcely a branch of pure science which may not contribute some knowledge which agriculture can apply. But agriculture differs from other industries in which a new discovery may be followed by a sudden transformation in methods. Agriculture is old, slow-moving, and conservative. The life cycle

[1] From the presidential address to Section M (Agriculture) of the British Association, delivered at Pretoria on Aug. 1.

animals runs into years, and even in cropping a tation of years must often be followed to get the ll effects of any change of method. Hence the re-lts of research are absorbed slowly and almost perceptibly into farming practice. Nevertheless, ere have been numerous instances when the ad-nce has been so rapid that the farmers applying e knowledge have been within sight of the source the knowledge.

The case of 'Marquis Wheat' is well known. is wheat, bred by the Canadian Experimental ation at Ottawa, has by its earlier maturity and perior cropping powers not only ousted the older d inferior varieties of wheat in millions of acres Canada and the northern United States, but it s also made the cultivation of wheat possible in eas where wheat could not be grown before. A riety of sugar cane has recently been produced in va by the Dutch plant breeders there; one of its cestors was not a sugar cane at all, but a wild reed owing in a marsh. Yet this variety, partly of reed cestry, is greatly superior to any other, giving 15- per cent more sugar and resisting local diseases tter than any other.

The grasslands of the Empire support at least 0,000,000 animals. If all these animals were ited to their environment, free from disease and erility, and sufficiently nourished, their value ould be far more than doubled or trebled. In dis-vering the cause of and the means of combating rtain insect-borne diseases, Sir Arnold Theiler d his associates have saved the Union of South rica millions of pounds. Equally spectacular is e biological control of noxious weeds, such as the ickly pear in Australia and the blackberry in New aland.

In the field of animal nutrition, it has been dis-vered that diseases may be caused in farm stock the absence of minute quantities of iodine, lime, osphorus, or vitamins. The cure of rickets in pigs, d styfsiekte and lambsiekte in cattle, by the ministration of bone meal and salt and other neral mixtures has already saved hundreds of ousands of pounds to stock farmers. The applica-n of the newer conception of the balanced ration ich we now have as the result of the studies of ysiologists and biochemists, is yielding its return increased production.

The intensive management of grassland in such eat grazing countries as Australia, New Zealand, d Great Britain is only beginning, but already it plain that production can be doubled under skil-l management.

These great achievements give us the assurance at the application of pure science to agriculture ll yield results of a value many times greater than e money expended.

It is clear that there are large economic problems fecting all parts of the Empire which await solu-n if the Empire is to be properly developed. ere is, for example, sterility and abortion in live ck. There is the pasture problem. There are ect-borne diseases. It is almost hopeless for a gle individual or even a single institution to at-mpt the solution of any of these great problems. Each problem has so many aspects that team work is needed in the widest sense—not only between individuals, but also between institutions and between governments.

The most recent development of the work on pastures has been in connexion with their chemical composition. It has been shown that chemical composition, if it takes account of all known food constituents, is an indication of the feeding value of pastures, and it has been proved independently in various parts of the world that deficiencies of one or other nutrients required only in small amounts, are the cause of definite diseases. Further, it has been shown that if these deficiencies are made good, not only are the diseases prevented, but also production is increased and there is reason to believe that susceptibility to disease generally is decreased, and what is also of great economic importance, animals breed true instead of undergoing the well-known deterioration which takes place in improved breeds when put upon poor pastures.

The better exploitation of the pastures of the Empire is a problem which requires, for a complete investigation, the pathologist and bacteriologist to deal with the diseases which occur in deficient areas; the physiologist and biochemist to deal with the composition of the pasture and to determine to what extent it meets the requirements of the grazing animal. There is needed also the work of the plant breeder and the soil chemist for the improvement of the pasture as a crop.

To bring about a concerted and co-operative attack upon such problems as these a certain procedure seems desirable, and facilities for co-operation are now immeasurably greater than they were even thirty years ago.

Empire Research.

Provided, then, that we have a large enough conception of Empire development by research the procedure should be:

(*a*) to outline the problem;
(*b*) to collect all available information concerning it;
(*c*) to make a plan of campaign;
(*d*) to find the money to finance the research;
(*e*) to find the men to do the work.

To carry out this procedure, it so happens that we are in a more favourable position than ever before in the history of the Empire. The urgent problems that arose during the War demanded a solution on immediately practical lines, and tremendous advances were made in some of the applied physical sciences. Following on this war experience, a similar spirit of co-operation has been developed in agricultural science.

In 1925 the British Government set up an Imperial Economic Committee, with an annual grant of £1,000,000 for the purpose of encouraging trade in Empire products in the British Isles. The Imperial Economic Committee recommended that the annual grant should be used, first, to create in the British Isles a voluntary preference for Empire goods, and, second, upon research to improve the

quality and supply of Empire goods for sale in Great Britain. The British Government, after consultation with the Dominion Governments, accepted the report and created the Empire Marketing Board, which is the executive body for the administration of the funds. The Empire Marketing Board early turned its attention to the encouragement of research as the second of its functions. Almost simultaneously with the creation of the Empire Marketing Board was set up the Committee of Civil Research.

It was borne in upon those who had inquired into research in the non-self-governing Colonies that much good work was lost in pigeon holes, that scientific workers were sometimes engaged on the same problems unknown to each other, that overlapping occurred, and that facilities for the exchange of information were inadequate. Accordingly, when the Imperial Agricultural Research Conference was held in London in 1927, it strongly recommended the creation of clearing stations or information bureaux for the collection and distribution of information concerning certain sections of agricultural research, and several of these bureaux are now in operation. They are all, by the unanimous decision of Empire delegates, situated in Britain. They deal with soils, animal nutrition, animal genetics, animal hygiene, plant breeding, animal parasitology, and fruit production. They are not research institutions, but in each case they are attached to research institutions, and their first directors are the directors of the research stations.

Each bureau will focus the information on the subject—will act as a gathering ground for theories and theorists, as an illuminant and expositor, and eventually we may hope, as a finger-post to new and profitable roads and by-paths of research. These bureaux, to which all governments of the Empire have agreed to contribute, embody the first organisation which is Imperially owned and Imperially governed, and which has been set up to serve the Empire. Each Dominion or Colony has its own problems peculiar to its conditions, but the fundamentals of science are everywhere the same.

We have, then, machinery to deal with three of the five necessities for Empire research. We have the bureaux to collect information. We have the Committee of Civil Research to consider the information and plan a campaign, and we have the Empire Marketing Board to provide the funds. As to the men, the great Dominions can and will provide and train their own men. The success of South Africa in the production of research workers whose reputation is world wide is sufficient evidence of what the Dominions can do. The case is different in the Colonies. As a rule, the research workers in the Colonies must be recruited from home or dominion sources and partly trained outside of the Colonies which they serve.

There is one aspect of the man power that must not be lost sight of in considering Empire research, and that is the desirability of exchange of workers. Nothing can be more profitable and stimulating in suitable circumstances than change of environment to the research worker. He obtains a new lease of scientific life, a wider outlook, a wealth of experience of men and methods denied to him as a limpet in an institution. There are difficulties in the way of exchanging workers on any considerable scale, but these difficulties will decrease as time passes and the temporary exchange of work and of workers will prove of far-reaching benefit.

We have available organisations or machinery capable of doing great things for the development of the Empire. Already much has been achieved. The Empire Marketing Board in two and a half years has made grants up to the end of 1928 aggregating to a million and a half pounds. A fine example of what has already been done in Imperial team work is offered by the grassland research. The headquarters of this research is in Aberdeen and the chief of staff is Dr. J. B. Orr. Under his direction, teams have been investigating the mineral deficiencies of pastures in Kenya, in the Falkland Islands, in Palestine, and in Scotland and England. Arising out of these investigations and those of Sir Arnold Theiler, similar campaigns have been started in Australia and New Zealand. Here in the space of only two or three years we have, through vision and staff work, an Imperial investigation which promises to increase enormously the output of beef and mutton from Imperial grasslands.

As a result of these pasture researches, the workers engaged have been in consultation with each other, and a spontaneous tendency to co-operation is bearing fruit. In consequence, the pioneer work of Onderstepoort is known and appreciated in Great Britain and elsewhere and is being applied successfully. The work of Aston in New Zealand on 'bush sickness' is being applied in East Africa. The Canadian work on the prevention of goitre in grazing animals is a stimulus to work in other countries such as Australia and New Zealand, where there is believed to be a deficiency of iodine in the pastures. If similar developments can take place in other lines of research there is a possibility of great advances during the lifetime of the present generation.

We have the only system of government in the world that can link up research in countries with all kinds of soils and climates. We have the finest and most varied laboratory in the world. We have the nucleus of an organisation and we have the opportunity.

Within the Empire is the Empire's greatest market for agricultural produce and the Empire's greatest source of supply. The development of agriculture would have an enormous influence in the development of Empire trade. Co-operation in research leads to better understanding between the Dominions, the Colonies, and the mother country. Conferences of research workers and administrators lead to the discovery of common aims and ideals, as was shown in the Conference of 1927, and the pursuit of common aims is one of the most enduring of ties. But the scientific man knows no boundaries; he is one of the few real internationalists in the world to-day; the knowledge he obtains is subject to no tariff, receives no bounty, is freely exchangeable throughout the world. As a scientific man—if he is within the British Empire—he may engage in the solution of larger problems than probably any other unit can provide.

What may be the end of this research ? One may speculate, but the end should surely include an orderliness, a co-ordination of parts, and a relationship of functions which should make for greater prosperity and for greater stability and freedom from temporary over- or under-production of agricultural commodities. It is not suggested that the exchange of commodities should be intra-Imperial. Even if that were desirable it is not possible. The trade of the Empire is shared almost equally between the Dominions and foreign countries. It is not that the Empire may be a self-contained and self-supporting quarter of the globe that I make these suggestions. To succeed in such an aim would be to end nowhere or to end in destruction. I make these suggestions because the nations which make up the British Empire form a political body which faces an opportunity open to no other system of governments in the world. This opportunity is the possibility that by taking thought and by organising the acquisition and the application of knowledge, the wealth of the Empire can be greatly increased, and thereby, and necessarily, the wealth of the rest of the world will be increased also. It is a far cry to an organised Empire, but if the object is worth it, the initial step is to adopt the ' view-point ' described by General Smuts. With the view-point and the mental field surrounding it come the creative ideas which in the end realise the dream. What I plead for then is the ' view-point '. Even in the prosaic occupation of agriculture, of the earth earthy, I suggest that the Imperial view-point is stimulating and creative.

The conception of an organised agriculture based upon science should, I think, be part of the mental equipment of every statesman and administrator. The same vision should inspire every research worker if, in the words of the late Lord Morley, he is to weave the strands of knowledge into the web of social progress.

If the vision is keen enough, the conception wide enough, the energy enduring, and the courage unfailing, is it not possible that the group of free nations which constitute the British Empire may demonstrate the means and lead the way to that wider world government to which every generous and contemplative mind would look ?

The Progress of the Motor Ship.

By Engr. Capt. Edgar C. Smith, O.B.E., R.N.

In Nature on Mar. 9 a short review was given of the progress of the steamship, and attention was directed to the advances made in the use of high steam pressures, water tube boilers, pulverised coal, and other means by which the efficiency of steam machinery is being improved. It was then stated that of 65,159,413 tons of shipping included in Lloyd's Register Book, 50,045,048 tons were driven by reciprocating steam engines, 9,682,063 tons by steam turbines, and 5,432,302 by oil engines.

The history of the ocean-going steamship extends over a period of about a century ; the first turbine vessel was the famous little *Turbinia* of 1894, while the first vessel driven by the modern heavy oil engine was probably a small canal barge built in 1903. In the case of the marine oil engine, as in that of the marine steam turbine, there was much pioneering work to be done before the new machinery secured the favourable opinion of shipbuilders and shipowners, and the development of the motor ship belongs almost entirely to the last twenty years. Of its growing popularity, however, there is no question, and for certain classes of vessels and for certain trades it will probably retain its position whatever advances are made in steam practice.

In 1914 the tonnage of motor ships was only 234,000, but by 1922 this had increased to 1,542,000, and the latest returns of Lloyd's Register show that no less than 40 per cent of the tonnage under construction will be driven by oil engines, and that larger and larger vessels are being supplied with oil engines. Of ships of 8000 tons and upwards now under construction, 27 will be driven by steam and 59 by oil ; of ships of 15,000 tons and above, 7 will be steam ships and 14 motor ships. Though no motor ship yet equals in size the *Majestic*, *Berengaria*, *Leviathan*, *Olympic*, or *Aquitania*, the Italian liners *Augustus*, *Vulcania*, and *Saturnia* are of 32,650, 25,000, and 23,940 tons respectively, the four British ships *Alcantara*, *Asturius*, *Carnarvon Castle*, and *Bermuda* range from 22,181 tons to 19,086 tons, and the new White Star liner *Britannic*, the largest British motor ship, launched on Aug. 6 by Messrs. Harland and Wolff, Ltd., is 680 feet long and has a gross tonnage of 26,840.

All large oil engines as found in motor ships have been developed from the independent inventions of Rudolph Diesel and Herbert Akroyd Stuart, both of whom patented engines in which the compression of the air in the cylinder caused its temperature to rise to the ignition point of the oil. Stuart's patent was taken out in 1890 ; Diesel's in 1892. Stuart's first engine was made in 1891, Diesel's in 1893, and in that year Diesel published his memoir, "The Theory and Construction of a Rational Heat Motor ".

Both inventors used the four-stroke cycle as introduced by Nikolaus Otto. In the Stuart engine fuel oil was sprayed into the air at the end of the compression stroke and was automatically ignited by a hot bulb extension to the cylinder end which was heated previously to the engine being started, but was afterwards kept hot by the explosions. In the Diesel engine, on the other hand, the air was more highly compressed and the fuel oil was injected by compressed air. No previous heating of the cylinder end was required, but the engine was started by compressed air.

The manufacture of engines working according to Stuart's plan, or the ' Akroyd ' cycle, was taken up by Messrs. Hornsby, and they were placed upon the market as Hornsby-Akroyd engines. The Diesel

engine was developed on the continent and always bore the inventor's name, and for some reason Diesel's name came to be applied also to engines working on the Akroyd cycle, and are even to-day known as ' semi-Diesel ' engines.

Stuart, who was born in 1864 and died in 1927, published many documents to establish his claim as an original inventor, and by his will left £700 to the Institute of Marine Engineers for a biennial prize for the best paper on " The Origin and Development of Heavy Oil Engines ". In an obituary notice of him it was said that he " belonged to that rather tragic fraternity of inventors whose achievements have not secured from the world at large the recognition they merited ". Without detracting in the least from the merits of the work of Diesel, it is undoubtedly true to say that Stuart was the first to bring out an engine with high compression and with timed injection of the oil fuel, while his method of spraying the oil into the cylinder, sometimes called ' solid ' injection or more properly ' airless ' injection, is used in many of the big engines for motor ships.

Diesel, it may be recalled, was born in 1858 and died in 1913. He apparently fell overboard while on passage between the Continent and England, but the mystery of his disappearance has never been cleared up. He lived long enough, however, to see Diesel engines at work in land stations all over the world, and also the beginning of their adaptation to ships.

The first boat driven by a Diesel engine was a canal barge fitted with an engine in 1903 by the Paris firm of Sautter Harle and Co. Five years later the *Delo*, of 4000 tons, fitted with an engine of 1250 h.p., was placed on service on the rivers of Russia. It is, however, with the *Vulcanus*, of 1900 tons, built at Amsterdam in 1910, that the history of the ocean-going motor ship begins. This vessel had a Werkspoor Diesel engine of 500 b.h.p. The next year the *Toiler*, built by Messrs. Swan, Hunter and Wigham Richardson, fitted with an engine constructed by the Aktiebolaget Diesels Motorer, of Stockholm, went from the Tyne to Halifax, N.S., and was thus the first motor ship to cross the Atlantic. At about the same time, the East Asiatic Company of Copenhagen built the *Sealandia* and *Jutlandia*, ships of 7500 deadweight carrying capacity, and these were equipped with engines of 2500 i.h.p., by Messrs. Burmeister and Wain. By 1914 there were about three hundred motor ships at sea, but while the War led to great activity in the construction of Diesel engines for submarines, it proved unfavourable for the development of such engines for merchant ships, and it is only during the last ten years that the large Diesel engine has become a familiar sight in our marine engineering shops.

Unlike the various types of reciprocating steam engines used in the past, all marine oil engines bear the names of the firms by whom they have been developed. Thus we have the Burmeister and Wain, the Werkspoor, the Sulzer, the M.A.N. (Maschinenfabrik Augsburg-Nürnberg), the Fullagar, and the Doxford engines. All these engines work on either the four-stroke principle, which we owe to Otto, or the two-stroke principle first introduced by Sir Dugald Clerk. Sometimes they are single acting, as in the ordinary motor car engine, sometimes double acting, as in the reciprocating steam engine. At present, the majority of motor ships have engines of the four stroke, single acting type, which for small and medium power have proved most economical in fuel, lubricating oil, and repairs. The number of cylinders, of course, depends on the power required, 4, 6, 8, or 10 cylinders being used.

One of the most notable motor ships of last year was the Nelson liner *Highland Monarch*, of 14,450 tons, which had two 8-cylinder four-stroke double acting Harland-Burmeister and Wain engines of a total horse-power of 10,000, and the *Britannic* will have two similar engines, but with ten cylinders instead of eight.

With the assured reliability of the marine Diesel engine, the decision as to whether a new ship should be driven by oil engines or steam engines is now influenced solely by the considerations of the economics of the problem, except in the case of very fast ships, for which the steam turbine retains its supremacy.

With every important change in the design of marine machinery, difficulties have been met with, and the oil engine was no exception to the rule. Whatever scepticism there was as to the reliability of the marine Diesel engine has been removed by the successful motor ships now afloat, and seeing it is possible to construct petrol engines which enable aircraft to maintain endurance flights of a fortnight, there can be no doubt as to the possibility of eliminating such defects as do occur in the internal combustion engine in ships.

The economics of up-to-date steamships and motor ships was the subject of some interesting remarks by Mr. J. Johnson in his paper entitled " The Propulsion of Ships by Modern Steam Machinery ", read to the Institution of Naval Architects on Mar. 21 last. Mr. Johnson was responsible for the design of the s.s. *Duchess of Bedford* and other interesting vessels for the Canadian Pacific Railway Company, which maintains services on the North Atlantic and North Pacific. Among the factors to be taken into consideration are first cost, fuel costs, weight of bunkers, and costs of repairs, and it was evident that for the particular services mentioned, Mr. Johnson held the view that the steam vessel was quite capable of holding its own against the motor ship. In some tables, he gave figures relating to two ships of 18,000 s.h.p. and 30,000 s.h.p. respectively. As regards the weight, the steam installations worked out at 4435 tons and 9640 tons, as against the 4765 tons and 9870 tons of the Diesel installations. In the steam ships the consumption of boiler oil was given as 0·63 and 0·60 per h.p. per hour, as against 0·48 in the motor ships. But owing to the much higher price of Diesel oil the daily fuel costs for the 18,000 s.h.p. ship on the Atlantic would, when running to Montreal, be £324 in the motor ship as against £262 in the steam ship, while the 30,000 s.h.p. motor ship on the Pacific would

have a fuel bill of £355 per day and the 30,000 s.h.p. steam ship £348 per day.

When the contract for the s.s. *Duchess of Bedford* was placed, quotations showed that the cost of a motor ship of similar capacity would have been £100,000 more. The price of coal, oil fuel, and Diesel oil differs at the various ports of the world, and Mr. Johnson illustrated this by a map. He also gave a tabulated statement of the coal and oil deposits of the world as at present estimated. This showed that whereas the coal deposits are equal to about 4000 or 5000 tons per head of population of the world, the deposits of oil are only equal to about 4 or 5 tons per head. It may be that superintending engineers of shipping companies at the present time are not influenced by these figures, but they have a direct bearing on the interesting question as to whether ocean transport in the future will depend on oil engines or steam engines.

Obituary.

Sir E. Ray Lankester, K.C.B., F.R.S.

WITH deep regret we record the death, on Aug. 15, of Sir E. Ray Lankester. For long he was the dominating figure among British zoologists, and he was recognised the world over as a great master in science owing to his achievements in biology and more particularly for his advancement of our knowledge of the morphology of animals. Those who met Lankester could not fail to see in him a man of exceptional intellectual power. His tall and commanding presence, his expressive face, his speech, all contributed to make up an impressive personality.

Edwin Ray Lankester was born in London on May 15, 1847, the eldest son of a well-known physician who became coroner for Central Middlesex. Educated in the classical tradition at St. Paul's School, London, he gained a scholarship at Downing College and went up to Cambridge at the early age of seventeen. Two years later, however, he migrated to the University of Oxford, where he entered Christ Church as a 'junior student'. Here he studied zoology, with his friend Moseley, under Rolleston, the first Linacre professor. Having graduated with first-class honours in natural science, and obtained the Burdett-Coutts scholarship in geology, and later the Radcliffe Travelling Fellowship, Lankester went to Naples in 1870, where he studied marine zoology with his friends Anton Dohrn, the founder of the famous zoological station, and Frank Balfour, the illustrious embryologist.

On his return to Oxford, Lankester was elected fellow and tutor of Exeter College, and began his teaching career. Two years later, in 1874, Lankester was chosen to fill the chair of zoology at University College, London. In 1882 he was appointed to the professorship of natural history in Edinburgh; but, finding the conditions of this post unsuitable, he resigned it within a fortnight, and was welcomed back to London, where he resumed the professorship at University College, which he retained until 1890. This was Lankester's best period, remarkable both for his success as a teacher and for the output of important original researches carried out in his laboratory by himself and his pupils.

In 1890, Lankester succeeded Moseley as Linacre professor of comparative anatomy at Oxford. Here, among his many activities, he greatly improved the laboratory facilities, and added a large modern building to his Department. He also devoted much attention to the reorganisation of the zoological section of the Museum, and the methods of displaying specimens with an eye to beauty and instruction. Of this experience he made full use when, in 1898, he was appointed Director of the Natural History Departments of the British Museum and Keeper of Zoology at South Kensington. These posts he occupied until his retirement at the age of sixty, in 1907.

Lankester's scientific work extended over the whole field of zoology. There is scarcely a group of animals he did not study, scarcely a problem he did not help to elucidate. Both his parents were cultivated people of intellectual interests. His father was a scientific man of distinction, a fellow of the Royal Society, interested more especially in microscopy, who contributed many papers to the *Quarterly Journal of Microscopical Science*, of which he was co-editor. In the congenial atmosphere of this family circle, where he met Huxley and other eminent men engaged in the controversies of those stirring days over the "Origin of Species", young Ray Lankester must have early developed that love of the wonders and beauties of Nature, that insatiable curiosity to know and understand, which inspired his work and lasted to the end of his career. Indeed, he began writing when a mere boy, and it is characteristic of the man that he never lost his interest in the subjects he took up; his enthusiasm and eagerness for fresh information were not blunted, nor did new interests crowd out old ones from his capacious mind. So we find that his first venture into print is a letter on Pteraspis (*Geologist*, 1862), beginning a series of contributions on a remarkable group of fossil fishes, and leading to the writing of the important monograph on "The Cephalaspidæ", published by the Palæontographical Society in 1868–70. This work is recognised as a classic on the subject. In 1863 appeared a note on the Gregarinidæ (*Quar. Jour. Mic. Sci.*, vol. 3), the prelude to a series of researches on parasitic Protozoa that won him a place of honour in the history of protozoology and parasitology.

The Protozoa had a peculiar fascination for Lankester, who was an expert in microscopy. Later in life he did much to promote the study of parasitic Protozoa in relation to disease at home and abroad, and the success of Minchin and others in this field owed much to his encouragement.

Lankester was only seventeen years of age when he wrote his first paper on the anatomy of the earthworm (*Quar. Jour. Mic. Sci.*, vol. 4, 1864); this

animal, he was fond of saying, is the rock on which morphology is built. From such observations he was later led to the study of the body-cavities of animals, and finally established that, while the body-cavity of annelids and vertebrates is the cœlom, in molluscs and anthropods it is of a different nature and filled with blood. This and other contributions made by Lankester have helped greatly in the clearing up of obscurities and the elucidation of many important points in the general morphology of various groups of Invertebrata, thereby laying bare their true phylogenetic relationships.

The masterly memoir entitled "Limulus, an Arachnid" (*Quar. Jour. Mic. Sci.*, 1881) is a triumph of Lankester's method, whereby he first proved the close affinity of this remarkable creature, known as the King crab, to the scorpion and not to the Crustacea as hitherto supposed. Another important line of research dealt with the development of molluscs; the memoir which followed (on "The Embryology and Classification of the Animal Kingdom", *Quar. Jour. Mic. Sci.*, 1877) contained many new and fruitful conclusions, and had a great and lasting influence on the science of embryology. His work on *Amphioxus*, and especially on its development, in collaboration with his pupil, A. Willey, also deserves special mention. On quite other lines were his pioneer researches on the pigments of animals, and his later work on flint implements. These are but a few of the subjects he studied.

In addition to these special papers Lankester wrote many works of a more general character. The articles he contributed to the "Encyclopædia Britannica", on Protozoa, Hydrozoa, Mollusca, Arachnida, Polyzoa, and general zoology, are masterpieces of scientific exposition; also his introductions to some of the volumes of the well-known "Treatise on Zoology", of which he was editor. Among his more popular, but not less excellent books, may be mentioned "Comparative Longevity" (1871), "Degeneration" (1880), "The Advancement of Science" (1889), "The Kingdom of Man" (1907), "Science from an Easy Chair" (1910), and "Great Things and Small" (1923).

It was in 1869 that Lankester, who had just graduated at Oxford, became co-editor with his father of the *Quarterly Journal of Microscopical Science*. Under his able sole editorship from 1878 until 1920 it became the leading British journal of scientific zoology.

The lasting value of Lankester's work depended, perhaps, most on the soundness of his judgment. In matters of morphology especially, a sound judgment, based on a broad foundation of accurate knowledge, a wide outlook combined with a well-trained and alert imagination, are necessary for success, and these are just the qualifications Lankester possessed. Eager as he was to hear of new discoveries, he was not easily led astray by the extravagant praise of some new theory. He delighted to share his knowledge with others, and to rouse in them the interest he so deeply felt. Hence he was a great teacher. In the simplest language he could give vivid descriptions or lucid explanations; with impressive mastery he could marshal the evidence and develop his argument. But perhaps his most precious gift was his power of selecting the essential, of picking out the important and discarding the unimportant. Neither in conversation nor in lecture were his statements obscured by irrelevant detail. He delivered inspiring lectures spontaneously, often without notes of any kind, trusting to his memory, to the specimens on the table, and the diagrams on the wall. He would illustrate them by skilfully executed drawings in coloured chalks on the blackboard.

Always ready to help and advise colleagues or pupils, Lankester took the keenest interest in their work. When consulted he never seemed at a loss for a helpful suggestion or an appropriate comparison drawn from his vast store of well-ordered knowledge. To any sincere inquirer he gave unselfishly of his best; those who worked with him owed much to his inspiration, for which he claimed no credit. But he never forced his opinions on them, and allowed them free choice to pursue their own lines of research.

Lankester's services to the cause of protozoology and medicine have already been mentioned. Even more has zoological science in Great Britain benefited by his help in the foundation of the Marine Biological Association and the erection of its Laboratory at Plymouth. For long he took an active interest in its welfare, and the proud position this laboratory now holds as a centre of biological research is largely due to him.

The reputation of Ray Lankester at home and abroad was great. Elected a fellow of the Royal Society so early as 1875, he was awarded the Royal Medal ten years later and the Copley Medal in 1913. From the Linnean Society he received the Darwin-Wallace Medal and the Gold Medal. A knighthood was conferred on him on his retirement from the British Museum. He received many honours from universities at home, and from numerous learned societies on the Continent and in America.

Lankester was a man of strong feelings, which he did not hesitate to express. Any form of sham, fraud, or injustice roused his anger, and his impetuous temperament sometimes led him into difficulties, even injured his worldly prospects. But he had high ideals and a kind heart. His many interests, artistic and literary as well as scientific, his great personal charm, won him many friendships. During his frequent visits to the Continent he made friends with most of the eminent zoologists of his day.

His friends will mourn his loss, but his work will remain and bear fruit, the best memorial to a life devoted to the advancement of science.

E. S. GOODRICH.

ZOOLOGICAL teaching in the broadest sense, including animal physiology, was given a new impetus in Oxford by the completion of the University Museum about 1860, in Cambridge by the inspiring personality and administrative power of Michael

Foster. The Oxford Museum, owing its existence to the prophetic vision and untiring efforts of Henry Acland, in alliance with the genius of Ruskin, began its work with George Rolleston as the forceful and arresting head of the "Linacre Department of Human and Comparative Anatomy and Physiology", the parent of four separate Departments—Zoology and Comparative Anatomy, Human Anatomy, Animal Physiology, and Anthropology.

Three great names—Balfour, Lankester, and Moseley—will always be associated with the revival of zoological learning in our two ancient universities; for it was in this period that their student years were passed, and each of them rendered invaluable service to his Alma Mater as a teacher, and, above all, as an inspirer of research.

Lankester was fortunate in his boyhood, living in a home which enjoyed the friendship of such leaders of scientific thought as Huxley, Edward Forbes, Hooker, Henfrey, Tyndall, and Darwin—to mention the names which arose in his mind in association with the centenary of Huxley's birth. After gaining a scholarship at Downing College, Cambridge, in 1864, Lankester paid a vacation visit to Oxford, and, as he has told me, was at once attracted by Rolleston's enthusiasm and all the interesting and stimulating excitement of the Linacre Department making its fresh start in the New Museum. He resigned the scholarship at Downing and in 1866 gained a Junior Studentship at Christ Church.

Lankester had taken his degree five years before I first went to Oxford in 1873. He had lectured in the Museum under Rolleston until the inevitable had happened and the two men separated—Lankester to teach in a laboratory fitted up for him at Exeter College, of which he had become a fellow and lecturer in 1872. Memories of that fellowship examination, with Huxley and Rolleston as examiners, reached me in the following year, and from them I learned that there were only two candidates—Lankester and Sharkey (now Sir Seymour Sharkey). The latter devoted his whole time to a single question—the functions of the spleen; Lankester to zoology in the strict sense. The work of both candidates was so admirable and so incommensurable that no award was possible on the examination, and Lankester was elected as the senior, and probably also because his subject was thought to be more useful for the students of that day.

Of the three Oxford Colleges with which Lankester was associated—Christ Church, Exeter, and Merton—Exeter was always nearest to his heart. Here were his dearest friends—Bywater, Pelham, and Jackson, and later on Moseley—and it is in the Hall of Exeter that his gift, the admirable portrait by John Collier, has hung for many years.

To one bound as I was to the Museum as an undergraduate and later as a demonstrator, Lankester and the Exeter laboratory were something of a mystery; but some of the students attended both institutions, and I remember D'Arcy Power (now Sir D'Arcy Power) telling me of the excellence of the zoological teaching in "the other place". There also remained on the hidden side of a blackboard a beautiful drawing in coloured chalks of a sea-urchin—a lingering memory of the time when Lankester lectured in the Museum; and, after many years, I was told that Rolleston had so far forgotten the old bitterness as to turn the picture round and explain it to the students.

Our long friendship, begun in 1883, when I went to see him in London about some papers for the *Quarterly Journal of Microscopical Science*, became close and intimate when he became deputy Linacre Professor during Moseley's illness and succeeded to the chair in 1891. Our gardens were only separated by a low wall, and some of the steps by which an easy passage was effected are still in existence. In 1893 we became colleagues, and I can never forget the warmth of his welcome to me as a brother professor.

Lankester's scientific career will be described by others who were more closely associated with his teaching and researches. I propose to speak of other sides of his personality as they were revealed in a friendship of more than forty-five years.

Only those who knew Lankester well can realise the warmth of his affection for his family and his friends, and the depth of his sympathy with them when in trouble. He was devoted to children and loved to amuse them. He had a most understanding feeling for living animals—for Sally the chimpanzee, and in more recent years for a young gorilla then living in London and taken from time to time for exhibition in the Zoological Gardens. In these Anthropoid apes and in his dog he was quick to recognise the terror aroused by the unexpected and oftentimes by the near presence of man. I especially recall his feeling for the gorilla looking out with a terrified apprehension upon the torrent of humanity in a London street. When it has been doubted whether animals possess reason as apart from intelligence, whether any animal can ever in thought ask 'why', he has spoken of the wonder "What is the meaning of all this?" which he felt might be recognised in the pensive expression of Sally.

A side of Lankester's character, sometimes insufficiently appreciated, was his essential and abiding boyishness. "I hear you're a very quarrelsome man"—the words with which he was received by Archbishop Temple when he called as a candidate for the directorship of the Natural History Museum—gave him just the opening he could make the most of, the one he would have chosen for himself. Like a boy he loved fun, and he loved fighting, but was always ready to make friends when the fight was over, a readiness not always exhibited by the other side. Lankester, if shewn to be wrong by a foe worthy of his steel, would express regret and apologise in the midst of the encounter. Once, when we were playing on the long since abandoned Hincksey golf-links and had reached one of the greens below the oak, far-famed as the "signal-elm" of Matthew Arnold's lovely poem, a ball, struck by a player far behind us, came bounding down the hill. Lankester watched its approach with rising wrath, and when it crossed our green and finally came to rest on the opposite

side, he stamped it into the ground. The player, after inspecting his buried ball, followed us to the next tee, and first explaining that he had struck from an impossible position and had shouted his apologies, proceeded to attack Lankester in the most violent terms of which he was capable, and his capacity was of a high order. Lankester at once said "I was wrong: I apologise". "I was wrong too: I ought not to have used such language", the other replied, and they shook hands. Lankester had mistakenly assumed that we had been followed by a heedless player who knew nothing and cared nothing for the rules of the game. The incident brings to light a weakness which increased with increasing age—a tendency to attach too much importance to small things, and especially to technical details of procedure or terminology which seemed to exercise an irresistible attraction for him. But this is a small failing in a very great man who has left a deep and enduring mark upon zoological science and upon the intellectual life of the Darwinian epoch. EDWARD B. POULTON.

The strong personality and penetrating mind of Ray Lankester must have exercised a strong influence on the lives of many of his old pupils, and the news of his death will be received by them with feelings of deep regret and grateful remembrance. As a student who attended the first course of lectures he gave at University College, London, I can well recall the impression he made upon me then. His personal appearance was not what I expected. It seemed to me almost incredible that a man who had gained such a great reputation should be so young, strong, healthy, and well dressed, and when he began to speak, his resonant voice and his clear and decisive sentences seemed to penetrate into my mind as no other teacher's had ever done before. In those days the students were more rowdy in class than they are now, and as a rule a great deal of time was wasted in partially successful attempts to maintain order. It struck me therefore as strange that in Lankester's classes there was never any disturbance: the men felt his power, they became interested in what he had to say, and they were satisfied to remain quiet. We all felt that the lectures given by him were not of the ordinary text-book stuff; their substance seemed to come direct from the zoological workshops of the world, and was illuminated by many brilliant generalisations and pungent criticisms.

Practical work in zoology in those days was almost a new thing: there were no books to help us, and the appliances provided were for the most part inadequate; but, as it was impossible at first to get demonstrators, we had the great advantage of the personal guidance and supervision of the professor himself, and it was in the practical class that some of us formed that deep reverence and affection for our master which has lasted throughout our lives. He hated carelessness or sloth, and at times his anger was terrible, but he freely gave his great skill in manipulation, his sympathy, and his wise advice to the earnest student.

When, in later years, we came into closer touch with Lankester as advanced students or as demonstrators, we marvelled at the rapidity with which he wrote and illustrated his original contributions to zoological science in several of its branches, and at his wide and accurate knowledge of the literature of the subject. It is true that there was far more untrodden ground and a great deal less literature to read in the late 'seventies than there is now; but, looking again at some of the papers written by him at that period, I still wonder at the originality and accuracy of his work.

For the first few years, I cannot remember how many, Lankester used to live in Oxford and come to London two or three days a week to give his lectures; but when the Jodrell endowment of his chair was made, he moved into lodgings in London, and I well remember the keen pleasure it gave me when I was invited to spend an evening with him. On those occasions I often met distinguished men of science of the day, and I never left without feeling that I had gained inspiration and instruction.

Lankester's conversation was not only interesting when it turned on scientific subjects. He had wide and liberal sympathies with all the important events of the day, and always spoke with original and decisive views. He was perhaps at his best when engaged in a campaign against some form of humbug or imposture. I can well remember his account one evening of the séance in which he and Dr. Donkin exposed the trickery of the medium Slade, who was afterwards and in consequence convicted at a police court and sent to prison. Lankester's hatred of imposture seemed to be a kind of religious fervour, and he would act without regard to or fear of the consequences. His public-spirited zeal in these matters naturally led to rancour and abuse from the friends and supporters of those whom he exposed; but if he made some enemies as a consequence, those who knew him best never wavered in the belief that in everything he did he was absolutely sincere.

He had a wide knowledge of the drama and a personal acquaintance with many of the leading actors of the day, and in art he had a cultured taste and an interesting critical faculty. On both these matters he spoke with interest and with authority. At the time when he was at University College he was not apparently specially interested in any kind of outdoor games; his passion for golf developed later. But I was present on one occasion when he and Francis Balfour were engaged in an amusing controversy on the respective merits of rowing and lawn tennis, Lankester, who had rowed in the Downing College boat, supporting rowing and Balfour lawn tennis.

The influence that Lankester had on the development of research in zoology during his tenure of the Jodrell professorship at University College, London, was widespread. As editor of the *Quarterly Journal of Microscopical Science* he was able to encourage good work, but it was principally on account of his wide and liberal sympathies with workers in various fields of research that his advice and help were so eagerly sought. At that time the study of embryology seemed to predominate over any other

ranch of research, and most of the younger men vere engaged either in working out the develop- ient of some animal from the egg or the organogeny f some of the higher forms. As an authority on mbryology, there were few men more distinguished han he was; but the older methods of comparative natomy and systematics appealed to him also, nd he was always ready to encourage serious work n any field that seemed to him to help in the olution of the current problems in biology.

I came less into touch with Lankester when he eturned to Oxford as Linacre professor, and doubt- ess others will write with better authority than I an of the subsequent periods of his life, but his nterest in the progress of science was maintained o the end, and he never failed to stimulate and ncourage those genuinely engaged in research. When I saw him last, only a few weeks before his leath, though feeble and in pain, he talked to me or nearly an hour about the fresh-water medusæ, leading for more research work and for better llustrations of these interesting little jelly-fish.

His old pupils salute at the passing of a great naster and cherish the memory of a sincere friend.

Sydney J. Hickson.

Ray Lankester will be remembered as a teacher vith unusual gifts, as an original and versatile nvestigator, and as a leader in scientific thought vho performed conspicuous service in advancing he study of morphology. Those who had the rivilege of knowing him could not fail to be mpressed by his forceful personality, his wide nowledge, and his critical judgment. Those of us vho were fortunate enough to be his pupils had a rofound admiration for the masterly way in which e handled his subject. His mental attitude, well described in his own words as that thriftless earning after knowledge, that passionate desire o know the *truth*, which causes the unceasing dvance of science, was infectious. In some of us vho first attended his lectures with no thought of naking a life-study of his subject (I speak from ny own experience) he induced the belief that the ursuit of zoology was the object most worth living or. His marked success in exposition is further hown by the valuable articles he contributed to he "Encyclopædia Britannica", for example those n Protozoa and Mollusca. In his later years he ublished frequent essays, addressed to a wider ublic and characterised by the same qualities vhich had made him so successful in a professorial apacity.

Lankester's "Notes on Embryology and Classifica- ion", republished separately in 1877 "for the use f students", was of outstanding value as an in- roduction to the principles of morphology and lassification. His insight and success in intro- lucing new nomenclature just where it was most anted are remarkably illustrated by this essay, n which can be found numbers of terms now in niversal use, as for example invagination, blasto- ore, stomodæum and proctodæum, trochosphere, ephridium, homoplasy, and many others. His essay on "Degeneration", a discourse delivered before the British Association in 1879, is another example of his success in marshalling facts to illustrate a general principle. Among his more special contributions to science his studies of *Apus*, *Limulus*, and *Scorpio* were extraordinarily interesting and suggestive.

Among Lankester's other services his connexion with the *Quarterly Journal of Microscopical Science* deserves particular notice. He became one of the editors of this journal in 1869, and for more than fifty years, during most of which he was the principal editor, he maintained this as one of the foremost zoological journals of the world.

At the meeting held on Mar. 31, 1884, for the inauguration of the Marine Biological Association, Prof. Huxley, then president of the Royal Society, stated that the matter was chiefly in the hands of Prof. Lankester. The important part which this Association has played, not only in the development of our knowledge of British marine zoology, but in the elucidation of general problems in oceanography, has been the result of his action taken at that time and of the interest in its affairs shown by him in his capacity as president of the Association in the years which have followed.

During the second half of the nineteenth century an enormous advance was made in the study of morphology (including embryology) and in the examination of its bearing on the theory of evolution. In this advance Lankester had a notable share. He was not merely the unquestioned leader of British morphologists, but also his influence on the advancement of zoological science was widely felt outside our own islands.

Sidney F. Harmer.

Ray Lankester's contribution to the progress of marine biology and fishery research in Great Britain should not be underestimated. When little attention was being paid to either subject, he saw clearly what was required and the lines upon which advance was possible. Taking advantage of the general interest in sea-fisheries aroused by the International Exhibition of 1883, he put forward practical proposals which resulted in the foundation of the Marine Biological Association and the establishment of the Plymouth Laboratory. The influence which he was able to exert in Government circles and in the City of London obtained the financial support required for the commencement of a scheme which he had envisaged on broad and far-seeing lines.

Later developments of the work have been only the unfolding of plans which were laid down by Lankester from the beginning. The original building at Plymouth contained rooms specially fitted for biochemical and for physiological work, and the study of what we now call ecology, to which he had already given the name bionomics, was one of the very first branches of marine research for which provision was made. The difficulties which he encountered and overcame were very great. No one in authority in England at that time had any

conception of the considerable expenditure which is necessary if research work at sea, even in coastal waters, is to be conducted with success and with safety to those engaged in it. It was a source of great gratification to him when, in later years, funds more adequate to the carrying out of his ideas were made available.

No one who ever worked with Lankester could fail to be impressed by the outstanding character of his intellectual ability, the breadth and essential rightness of his outlook, and the value of his judgment on any matter to which he had devoted serious thought. It was only necessary to convince him of the soundness and disinterestedness of a scheme to ensure his help and support in its execution. He never fought for the love of battle, though anything which seemed to him to savour of incompetence or pretence called forth a vigorous response. He never bore malice, and was full of gratitude and kindly feeling to those with whom he co-operated. No man of his generation did more for the advancement of scientific thought and especially for the advancement of biology.

E. J. ALLEN.

News and Views.

HEARTY congratulations are due to Sir Thomas Muir, the veteran mathematician, who celebrates his eighty-fifth birthday on Aug. 25. He has been resident for upwards of forty years in Cape Colony. Muir was born at Stonebyres, Lanark, Scotland, and educated at Wishaw School, graduating at the University of Glasgow. Filling, in an interim, a post as mathematical tutor at St. Andrews, he returned to his old university in 1871, becoming assistant professor of mathematics there; afterwards he was headmaster of the mathematical and scientific departments in Glasgow High School. In 1892 Muir was appointed Superintendent-General of Education in Cape Colony, holding office until 1915, when he received the honour of knighthood in recognition of long and arduous work in new fields of educational effort demanding vision and strength of purpose.

SIR THOMAS has been a prolific author of papers contributed to the Royal Society of Edinburgh, the *Messenger of Mathematics*, and *Philosophical Magazine*, as well as to the publications of the South African Philosophical Society. He was an active promoter of the programme of the British Association on its first and memorable visit to South Africa in 1905. In 1910, Sir Thomas was president of the Cape Town meeting of the South African Association, and delivered an address on "The State's Duty to Science". The Royal Society of Edinburgh has on three occasions awarded him the Keith gold medal for researches into the theory of determinants and allied subjects. Sir Thomas was elected into the Royal Society of London in 1900.

DR. NORMAN DAWSON ROYLE has been awarded the Walter Burfitt Prize of the Royal Society of New South Wales for his contributions to the study of muscular action and his investigations into the problems of muscular paralysis. The prize has been adjudged to him by the Council of the Society for papers published during the years 1926–28. This is the first award of this triennial prize, which is to be given for the papers of highest scientific merit published during the previous three years by a worker in pure or applied science resident in Australia or New Zealand. Dr. Royle has been engaged for nearly fifteen years in research into the manner in which the contractions of muscles within the body are controlled by the nervous system. His discoveries have added a new conception to our knowledge of the type of nervous control of muscular movement. The idea that nervous impulses are conveyed through nerves of the sympathetic system into muscular fibres has attracted world-wide interest. His discovery has thus illuminated that field of physiology, rescued from darkness by the genius of Magendie at the beginning of the nineteenth century, added to the brilliant picture of the mechanism of the regulation of motion by nerves expounded by Claude Bernard, and extended our view of reflex action elaborated with so much detail by Sir Charles Sherrington. Not only have these contributions given to us a better explanation of muscular movement, but also they have formed the basis of new means of treatment which have given a new life to many cripples who had never expected to walk again.

THE problem presented by the buffalo fly (*Lyperosia exigua*) is causing much uneasiness in the northern cattle-raising areas of Australia. The fly no doubt came originally from Java. It is not a pest there, partly because of the existence of natural enemies and partly because the Javanese cattle are much less affected by it than the European breeds of Australia. A few years ago the area of incidence was small, being confined to the immediate neighbourhood of Darwin and the northern coastal region of Western Australia. To-day the fly is found very much farther south, it has entered Queensland on the east, and is spreading rapidly to the west. All the country round Wyndham is heavily infested. Recent reports are that the cattle boats have brought it to Fremantle, but whether it can live so far south remains to be seen. The fly attacks chiefly the flesh at the base of the horn, or any broken portion of the animal's skin. The irritation to which it gives rise prevents the cattle from resting, either by day or by night. The raising of fat cattle for slaughter is rendered almost impossible at certain seasons, and, indeed, it seems possible that this pest may prove to be a main limiting factor in beef production in the northern areas of the Commonwealth. In view of the world position in the beef industry, the situation is disquieting from an Empire point of view.

DIPPING methods are useless in dealing with a winged pest of this type: in any case they are out of the question in areas where a cattle muster is possible only once every year, or perhaps two years. A measure of con-

ol by parasites or predators seems to be the only actical possibility. Dr. Nieschulz, of the Veterinary stitute at Buitenzorg, has already carried out some vestigations for the Council for Scientific and Inustrial Research, and has found in Java four parasites hich may prove to be of use. Two officers of the ouncil are now continuing this work, which lapsed hen Dr. Nieschulz returned to Utrecht last year. At e same time another entomologist is studying the bits and life-history of the fly in the Northern rritory. Among other questions to which answers ust be obtained is that of whether or not the fly is rried by native animals and can breed in their dung. n affirmative answer means that the position bemes very serious, since 'buffer areas' cannot then be ade effective in preventing spread. The two probms of the striking of sheep by certain species of owfly and the irritation in cattle by *Lyperosia* are hongst the most serious and difficult which the imal industry in Australia is facing to-day.

The research scheme of the Institute of Brewing s a record of which any such organisation may be oud. In the first place, the whole of the financial pport is provided by the 303 firms of brewers, altsters, and barley and hop growers constituting its rporate membership, and the satisfactory state of finances is an indication of the appreciation by an portant industry of the value of research. Secondly, the Memorandum for 1929 shows, the achievements the scheme are no less creditable and amply justify e trust implied in the provision of such large sums money. The brewing and allied industries, perhaps ore so than many others, have reached their present sition largely through accumulations of practical perience, and there are consequently numerous unlved problems. The advisory sub-committees of e research scheme have therefore had to fling a de net in order to embrace as many of these as ssible. Studies of the breeding, cultivation, storage d evaluation of hops and barley carried out in llaboration with several agricultural research stations ve already yielded numerous valuable results, ferences to which have appeared from time to time our columns, while the work of the late H. T. own on the action on yeast of non-assimilable wort oteins is also being continued. In addition, the uch-criticised problem of hydrogen ion concentran has been studied intensively, and a report issued the practical advantages of the adjustment of *p*H lues in the brewery.

Museums need not be mere storehouses of inimate objects; a thoughtful staff can do much to ild around the specimens in their care the reflection a human setting, thus enabling the significance of e exhibits to be appreciated by an ever-widening cle of interested visitors. An example of such atment is afforded by the recently issued handbook the collections in the Science Museum, South nsington, illustrating industrial chemistry (London: M. Stationery Office. Price 1*s.* net). This volume, hough containing a descriptive catalogue of the lections, differs from previous catalogues in that considerably more than half the book is devoted to illustration of the development which has taken place in that branch of science. Hence there is provided a background of human interest against which the exhibits themselves may be studied, and some idea of the course of evolution of a great modern industry may be gained. The museum authorities, and in particular the compiler, Mr. A. Barclay, are to be congratulated on producing a handbook which is not unworthy of a permanent place in any library of historical chemistry. The scene surveyed is, of course, so wide in its extent and so varied in its aspects that even the principal portions of it can receive but brief treatment and incomplete illustration. That such should inevitably be the case detracts in no way from the advantage of the method of presentation adopted or from the interest of the exhibits—nearly one hundred—which are to be found in Gallery LXVI. of the Science Museum.

The Handbook deals with the origin and early history of industrial chemistry; technical chemistry in the Middle Ages; industrial chemistry in recent times; mineral acids, alkalis, and allied products; coal tar distillation products; explosives; artificial dyes; artificial silk; fermentation processes; mineral oil products; and one or two other examples of chemical technology. The catalogue differentiates between inorganic and organic processes, and gives a technical account of the corresponding exhibits. There are described, for example, models of various types of plant for the manufacture of sulphuric acid, including the first type of plant to have sulphur burners separate from the leaden chamber. A model of a Cheshire salt plant illustrates the manufacture of blocks of common salt from brine by evaporation in open pans, as carried on in Cheshire at the present day, whilst other exhibits represent the cement kiln erected by William Aspdin, son of the inventor of Portland cement, and a modern plant including the rotary kiln. Yet other models depict processes for the production of black powder, gun-cotton, nitroglycerin, and trinitrotoluene. Early specimens of artificial silk made by the cuprammonium, nitrocellulose, and viscose processes, and samples illustrating the acetate process are included in the collection. Stills for the preparation of whisky, for the manufacture of alcohol, and for the refining of mineral oils are shown, together with oil shale retorts, and certain examples of general plant. The handbook is well illustrated by photographs of actual operations as well as of certain of the museum exhibits.

The scheme for the electricity supply of the north-east of England has now been published. It covers an area of about 5000 square miles, and includes the counties of Northumberland, Durham, and part of the North Riding of Yorkshire. This area is almost the same as that covered by the Newcastle-on-Tyne electricity company and the companies associated with it. The population in the area is about two and a half millions, and notwithstanding the depression of the shipbuilding, coal-mining, and iron and steel industries, some important industrial

developments have taken place there during recent years. At Billingham there is one of the most important plants in the world for the production of synthetic nitrates. The Newcastle company at Dunston has started low temperature carbonisation, and several very flourishing companies are manufacturing electrical plant and switchgear. Under the new proposals, six of the existing stations have been selected and will be operated by the Central Electricity Board. Four of these will be interconnected with the main transmission line at 132,000 volts. An extension from the North Tees station links up through Scarborough with the mid-east England scheme. Secondary lines operating at 33,000 volts will carry the system to Northallerton and Thirsk, where it will again join the mid-east scheme in the North Riding. It has been estimated that this system of interconnexion will bring 80,000 kilowatts of plant which at present is kept as a reserve into active operation. This means that more than a million pounds of capital now lying idle will become revenue-earning The Government scheme has standardised the frequency of fifty, and unfortunately the frequency in this area is forty. No further 40-cycle plant will be purchased, and gradually the whole system will be converted to the standard frequency.

It would appear that the great Shyok ice dam has burst at last. Last year at this time (NATURE, Aug. 25, p. 285) it was reported that the dam had been broken, but it proved to be a false alarm. This time the magnitude of the Indus flood reported by correspondents of the *Times* at Peshawar and Lahore leaves little doubt that the huge artificial lake in the Karakoram Mountains caused by the Little Khumdan glacier has burst. It is stated that the flood reached its maximum at Attock on Aug. 19, the Indus being more than 50 ft. above normal and only $3\frac{1}{4}$ ft. lower than the previous highest flood, and is now subsiding. The Attock railway bridge apparently has not been damaged; it has been constructed specially to withstand such floods. Extensive precautions have been taken lower down the Indus at Sukkur and at Karachi. Owing presumably to the swift warning given of the approach of the floods, there has been little loss of life.

The medal of the Institution of Mining Engineers has been awarded to Mr. George S. Rice, chief mining engineer of the United States Bureau of Mines, Washington, "in recognition of his eminence in all matters relating to the safe working of coalmines and the well-being of mine workers, with special reference to the practical application of scientific knowledge".

We learn from Kew Observatory that a message broadcast from Arlington gives some details of an earthquake registered at American stations at about 20 hr. G.M.T. on Aug. 15. The co-ordinates of the epicentre are given as 4° N., 82° W., that is, under the Pacific Ocean near Central America. The shock was recorded at Kew as a small disturbance at a distance of about 9000 km. Small earthquakes were also recorded at Kew Observatory on Aug. 17 (preliminary tremors arriving at 23 hr. 53 min. 11 sec. G.M.T.) and on Aug. 19, at 2 hr. 56 min. 1 sec. G.M.T. Both shocks appear to have originated at an epicentre 5800 miles away, probably near Central America.

The National Radium Trust, which is constituted as follows: Lord Parmoor (chairman), Mr. Arthur Greenwood, Mr. W. Adamson, Sir Ernest Rutherford, Sir John Rose Bradford, Lord Moynihan, Lord Dawson, Lord Mackenzie, Prof. A. H. Burgess, and Viscount Lee, has made preliminary arrangements in connexion with the purchase of radium, with the view of placing it as soon as practicable at the disposal of the expert body, the Radium Commission. The Commission has now been set up in accordance with the provisions of the Royal Charter, and is composed as follows: Viscount Lee (chairman); Lieut.-Col. Smallman, Medical Officer of the Ministry of Health; Mr. H. L. F. Fraser, Assistant Secretary of the Department of Health for Scotland; Prof. Sidney Russ, Professor of Physics, Middlesex Hospital Medical School; Dr. G. W. C. Kaye, Superintendent of the Physics Department of the National Physical Laboratory; Dr. J. M. W. Morison, lecturer in radiology, University of Edinburgh; Prof. G. E. Gask, professor of surgery, University of London; Mr. W. Ernest Miles, surgeon to the Cancer Hospital, Brompton; Dr. Comyns Berkeley, gynæcological surgeon to the Middlesex Hospital; Dr. Carlton Oldfield, professor of gynæcology, University of Leeds, and Prof. A. J. Hall, professor of medicine, University of Sheffield.

The "Statistical Report of the Health of the Navy for the Year 1927" has recently been issued (London: H.M. Stationery Office. 5*s*. net). With a total force of 93,230, both the incidence of disease and the invaliding ratio show decreases compared with the previous five years' average. Only 18 cases of typhoid and paratyphoid fevers, and 5 cases of Mediterranean fever occurred. Malaria with 332 cases shows a fractional decrease. Of influenza there were 2562 cases, though with only one death. With 6239 cases, venereal diseases show a decrease compared with the five years' average and with 1926. A short summary is included of research work carried out at the Royal Naval Medical School, Greenwich.

Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, have recently circulated a most interesting catalogue (New Series, No. 3) of atlases and maps of all parts of the world, ranging from the fifteenth century to the present day. The catalogue is beautifully printed and contains a reproduction, in colour, of Blaeu's View of Flushing, 1649, from one of the works listed; also several maps in black and white and a number of useful bibliographic notes which should prove of interest to geographers. The same firm has also issued a catalogue (No. 518) of nearly 300 works (books, maps, views, early parliamentary papers and newspapers) relating to New Zealand.

Applications are invited for the following appointments, on or before the dates mentioned:—A lecturer in the Department of Pathology of the University of

iverpool—The Registrar, The University, Liverpool ept. 2). A full-time lecturer in engineering at the nderland Technical College—The Chief Education fficer, Education Offices, 15 John Street, Sunderland ept. 9). A cotton research botanist under the dian Central Cotton Committee for research work the Bombay Presidency—The Secretary to the igh Commissioner for India, General Department, 2 Grosvenor Gardens, S.W.1 (Sept. 21). A senior cturer in economic history in the University of elbourne—The Agent-General for Victoria, Victoria ouse, Melbourne Place, Strand, W.C.2 (Sept. 30). senior lecturer in economics in the University Cape Town—The Secretary, Office of the High ommissioner for the Union of South Africa, South frica House, Trafalgar Square, W.C.2 (Oct. 1). A lecturer in physics in the University of Reading—The Registrar, The University, Reading. A full-time assistant in electrical engineering at the Technical College, Wolverton — The Principal, The Technical College, Wolverton, Bucks. A handicraft teacher under the Warwickshire Education Committee—The Director of Education, County Education Office, Warwick. A draughtsman for technical publications work at the R.A.E.—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 363). An assistant metallurgical chemist at the Sheffield Metallurgical Laboratories—The Metallurgical Laboratories, 1 Staniforth Road, Sheffield. A technical instructor for the posts and telegraphs department of the Government of Nigeria — The Crown Agents for the Colonies, 4 Millbank, S.W.1.

Our Astronomical Column.

Two New Comets.—After a blank interval of some x months, two new comets were discovered at the ginning of August. 1929 *b* was found by Prof. G. eujmin at Simeis Observatory, Crimea, on Aug. 2. rof. G. Neujmin had previously discovered two mets: 1913 III., period 18 years; 1916 II., period 5 years. The second was seen again at the return 1927. The following observations are from *U.A.I. rculars* 224 and 225:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Observer.	Mag.
g. 2·9547 U.T.	21h 16m 2·0s	12° 45′ 48″	G. Neujmin	13·5
4·9693	21 15 19·4	12 55 9	M. Wolf	14·5
6·9318	21 14 34·4	13 4 32	M. Wolf	—

he second and third positions are from photographs Königstuhl. *Circular* 226 gives the following osition and motion of an object observed at Lick bservatory by Messrs. Krieger and Bobrovnikoff:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Mag.
ug. 12·3505 U.T.	21h 13m 18·6s	13° 37′ 51″	15·0

Daily motion – 50s, S. 8′.

his may be the comet, but the motion in R.A. is ther more rapid than that suggested by the first ree positions. Prof. M. Wolf at first gave the follow- g position for Aug. 4:

Date 1929.	R.A. 1929·0.	S. Decl. 1929·0.	Mag.
ug. 4·9478 U.T.	21h 14m 27·1s	12° 28′ 24″	15·0

Daily motion – 52s, S. 1′.

fterwards he announced that this object was a minor anet, not the comet.

A later message states that a computation of the bit by Strömgren gives the date of perihelion as ly 3, distance at perihelion 2 units, period 12 years. The other new comet was found on Aug. 1 by r. A. F. J. Forbes, of Rosebank, Cape Town. He ll be remembered as the discoverer of comet ons-Coggia-Winnecke-Forbes in November last. The following position is from *U.A.I. Circular* 224:

Date 1929.	R.A.	S. Decl.	Motion.
ug. 3·750 U.T.	20h 0m 52s	30° 26′	North-West.

telegram on Aug. 8 threw some doubt on the direc- on of motion, and apparently on the reality of the met, but *Circular* 226 states that the latter is con- med, and gives the magnitude as 11. No further servations have come to hand.

The August Perseids of 1929.—Mr. W. F. Denning ites: "The shower of meteors occurred this year ien the moon was absent from the morning sky d this circumstance favoured observers. Aug. 10 s cloudy except in the early part of the night and little could be seen. Aug. 11 proved mostly clear except for about two hours between 11h and 1h G.M.T. in the early morning of Aug. 12. Meteors were not very numerous, but many of them were of conspicuous brilliancy; in fact what they lacked in umbers they compensated for in their lustrous and attractive aspects. More than thirty were estimated to equal the apparent magnitude of either Jupiter or Venus, and their long paths and vivid streaks formed striking features. Three observers at Bristol observed about 320 meteors during the night following Aug. 11, but the watch was not continuous and clouds partially interfered during two hours of the time.

"Aug. 12 came in clear, but meteors gave evidence of a decline in numbers and particularly after 11 P.M. In fact, they became so scarce at 0h 45m A.M. on Aug 13 that observations were discontinued. In past years the night of Aug. 12 has often proved very prolific in meteors, but the experience this year was very different."

Future of the Moon.—Dr. H. Jeffreys contributes a third article to the *Realist* for August on the earth-moon system. He notes that the strength of the hypothesis of Sir George Darwin on the birth of the moon by tidal disruption of the earth lies in the coincidence that the initial rate of rotation of the earth (about 4 hours) is found in two ways: (1) from the moment of momentum of the earth-moon system; (2) from the necessary period for tidal magnification through resonance; and these give accordant results. He makes more definite estimations of time than Darwin ventured upon; he gives 4000 million years for the past duration of the system, and states that it will take a period ten or a hundred times as long for the moon to reach its maximum distance. Since the return of the moon will be much slower than its recession, the estimate that in a billion years from now the oceans will be frozen even at the equator seems to put the further development of the process outside practical politics. Dr. Jeffreys notes two points of interest: Roche's limit ceases to apply for bodies that are only a few miles in diameter; thus Phobos could approach close to the surface of Mars without disintegrating. This point was overlooked by Sir George Darwin, who suggested that its disintegration was imminent, owing to its proximity to Roche's limit. The other point is that the moon's interior is likely to contain a considerable proportion of radioactive elements, which have retarded its cooling. Hence a period of mountain formation through shrinkage may still be in store for the moon.

Research Items.

Sociology of the Californian Aborigines.—Volume 26 of the *University of California Publications in American Archæology and Ethnology* is an extensive study of aboriginal society in southern California by Dr. William D. Strong, for which the materials were gathered in 1924–25 from the Serrano, Cahuilla, Cupeño, and Luiseño Indians, now living on reservations in Riverside and San Diego. These peoples retained their old culture much later than the peoples of the coast, yet the work of the ethnologist is very much that of the social palæontologist and must therefore be largely reconstructive. Complete understanding is impossible. No trace of tribal organisation appears. The social unit is the local autonomous group of male lineage; but important social and religious functions are associated with group priest, ceremonial house, and sacred bundle or fetish, often welding several collateral lineages into one group—an added bond to that of kinship. A dichotomous organisation of society more extended than the simple male lineage is indicated by such concepts as exogamy, reciprocity, a dual conception of the universe especially as regards animals, the use of dotted and striped facial designs to distinguish the moieties and a similar use of red and black paints. This dichotomy was superimposed on the localised lineage organisation. Hence the designation of lineage and not moiety characterises the classification of relations among all groups. There was a comparatively early intrusion of cultural traits, tentatively assigned to the Pueblo culture, in the coastal region. In southern Californian ceremonialism, female puberty rites and ceremonies to drive away the spirits of the dead underlie all other cult activities. On this widespread substratum have arisen the elaborate cult activities containing many Puebloan activities; but the old basic ideas persisted and are the more important sources of ceremonial motivation in south California.

Anatomy of Freshwater Mussels of the District of Columbia.—Five genera of Unionidæ are native to the District of Columbia, U.S.A., and anatomical descriptions of five species are given by Lucy Reardon (*Proc. U.S. Nat. Mus.*, vol. 75, art. 11). Two of these belong to the genus *Lampsilis*, one to *Anodonta*, and two to *Elliptio*. Only in the first species dealt with is the complete anatomy set forth; in the rest the details are successively curtailed and no comparisons are made. The author seems to have relied on her series of diagrammatic figures, which, though very clearly drawn, have been unnecessarily reduced in size with corresponding loss of value.

Polyvitelliny in Pond Snails.—The occurrence of more than one vitellus, or embryo, in a single egg of some of the fresh-water pulmonates has never been satisfactorily explained. E. D. and R. M. Crabb have made a study of the subject in *Limnæa* and *Physa* (*Biol. Bull.*, vol. 53) and find that polyvitelline eggs may be expected to occur among normal eggs. They found that the included vitelli vary in number from two to as many in one case as forty-six, and that true twins do not occur. It appears probable that the ova passing down the filiform part of the hermaphrodite duct where it bends round the gizzard are inhibited to such an extent by the actively contracting gizzard that several ova accumulate in the enlarged part of the duct, and that during a period of reduced activity of the gizzard all pass into the convoluted uterus at one time and become enveloped by the albumen and the egg membrane which would normally cover a single vitellus.

The Ganglion Cells of Earthworms.—F. Ogawa (*Sci. Rep. Tôhoku Imp. Univ.*, Ser. 4, vol. 3, No. 4, Fasc. 2) has investigated the number of ganglion cells in the corresponding ventral ganglia of three species of earthworms of the genus *Perichæta* which live together and have similar body sizes. The ganglion of the 30th segment was first observed, this being selected because of the simple arrangement of organs in that region in all three species, and the average number of ganglion cells was found to be 1208, 1171, and 1141 respectively. In the ganglion of the 18th segment of specimens of *Perichæta hilgendorfi* and *P. vittata* which did not possess a prostate gland, the number of ganglion cells was 1519 and 1532 respectively, but in the ganglion of the 18th segment of *P. communissima*, which possessed prostates, the number of cells was found to be 4050. A variety of *P. vittata* with paired prostate gland in the 18th segment was found to have 3433 ganglion cells in the 18th ganglion, hence the presence of the gland causes the ganglion cells to increase in number. But this increase in the number of cells produces only a slight increase in the volume of the ganglion, the cells being more crowded.

Reproduction in Sea Anemones.—T. A. Stephenson (*Jour. Mar. Biol. Assoc.*, vol. 16, No. 1, May 1929) has studied, with regard to their reproductive processes, eight species of British sea anemones, namely, *Sagartia elegans*, *lacerata*, *sphyrodeta*, *troglodytes*, and *anguicoma*, *Cereus pedunculatus* and *Diadumene cincta* and *luciæ*. Deposition of ova may co-exist with any other method of reproduction, except perhaps in certain viviparous forms. Apart from this, one method only prevails in any one of the selected species. Longitudinal fission occurs in *S. sphyrodeta* and *D. luciæ*, laceration by tearing in *S. elegans* and *D. cincta*, laceration by constriction in *S. lacerata*, while *S. troglodytes* and *C. pedunculatus* are viviparous. In *S. anguicoma* neither viviparity nor asexual reproduction occurs. The viviparous forms studied do not reproduce asexually, nor are those which reproduce asexually viviparous. Pieces were cut off from the margin of the base (artificial laceration) of four of the above species. In *S. elegans*, which lacerates naturally, nearly 100 per cent of the pieces regenerate easily, and the same is true of *S. lacerata*. In *S. troglodytes*, which does not lacerate naturally, only two out of seventy-six pieces regenerated fully, but in *S. anguicoma* the percentage was much higher. The author refers to the sixteen specimens living in Edinburgh of *C. pedunculatus*, the age of which is at least seventy years, and records that one of these aged examples in 123 days in 1925 produced 102 young.

Species of *Phytophthora* in Malaya.—The economic importance of plant diseases caused by *Phytophthora* spp. is considerable, particularly in tropical regions. From this point of view, A. Thompson (*Malayan Agric. Jour.* **17**, 53, 100; 1929) has recently studied diseases of rubber, Roselle fibre, and betel vine plants from which a number of strains of *Phytophthora* have been isolated and described. Those from rubber are responsible for the diseases known as black stripe, patch canker, and pod-rot. Western Malaya is, however, comparatively immune from some *Phytophthora* diseases known elsewhere, apparently owing to the drier conditions in the early part of the day.

A Polyploid Species.—*Prunus laurocerasus* is shown by Meurman (*Jour. of Genetics*, vol. 21, No. 1) to have a remarkably high chromosome number, 170-180 chromosomes being counted in a plant at Kew. This number probably represents twenty-two times the basal number eight. The chromosome segregation is irregular in pollen formation, so that gametes with various numbers are formed. The chromosomes are

ually in higher groups than pairs, occurring in the duction division in threes, fours, fives, sixes, and vens. Probably still larger groups of homologous romosomes are associated in some cases, as well as tain univalents which may split in the first reduc- n division. The possible origin of this highly lyploid condition is discussed.

Petal-colour and Hydrogen Ion Concentration.—It commonly stated that anthocyanins are red in d and blue in alkaline or neutral media, but ssrs. Buxton and Darbishire (*Jour. of Genetics*, l. 21, No. 1) found that the petals of some red- wered plants will not turn blue at all in passing m acid to alkali. A series of tests were then made the flowers of various common plants, by pounding the petals and placing them in media ranging from H 3 to *p*H 11. Usually the blue flowers run through l, pink, and violet to blue at the neutral point, en becoming greenish and finally yellowish, with reasing *p*H, owing to the presence of flavones. is was true of *Aconitum*, *Aquilegia*, *Campanula*, *lphinium*, *Lathyrus*, *Linum*, *Primula*, *Salvia*, and ers. In clear red flowers, such as *Begonia*, *Dahlia*, ppy, rose, and *Tropæolum*, on the other hand, the lour series with increasing hydrogen ion concentra- n runs from vermilion to pink and purple or ownish tints (the latter due to flavones) without er becoming blue. *Salvia splendens* belongs to the ter series, while the blue *S. patens* remains blue m *p*H 4 to *p*H 8. Flowers with various intermediate ades of purple, magenta, or pink contain in their tals mixtures of the blue and red anthocyanins in rying proportions. The cell sap of a red or purple wer is therefore not necessarily more acid than that a blue flower, and a red mutation could arise from blue flower without any change in the *p*H of the l sap.

Mineral Wealth of the Black Hills of Dakota.—In e Black Hills of Dakota an unusual variety of nerals are to be found, many of them of great nomic value. During the fifty years of their tlement, this area has produced one-eightieth of the gold known to have been mined in the history the world, and it still boasts the largest low-grade d mine now working. Here, too, occurs the greatest nia-producing mine. Mica and felspar are mined, gether with rarer minerals such as columbite, ntalite, beryl, tinstone, and wolfram. J. P. nnolly and C. C. O'Harra have published a com- ehensive and up-to-date account of the geology and neral wealth of the Black Hills in *Bull.* 16 of the uth Dakota School of Mines (May 1929, pp. 418+ plates). The bulletin contains a valuable study pegmatites and of the celebrated Homestake Mine, well as a convenient summary of the history and nomics of the region. It should not be overlooked mining geologists or mineralogists.

Neogene Shells from Japan.—A further contribution m Prof. Matajiro Yokoyama (*Jour. Fac. Sci. Imp. niv. Tokio*, Sect. 2, vol. 2) describes some Neogene lls from certain provinces of Chūgoku, the south- stern extremity of the Main Island. Those from province of Iwami are probably Pliocene, but ether the others are Pliocene or Miocene it is at sent difficult to say. Twenty-nine species in all recorded, and of these four new species are scribed as well as a form which is almost in- tinguishable, although smaller, from the *Arca nulœnsis* Osmont, from the Fernando formation California.

Japanese Polymorphinidæ.—Dr. J. A. Cushman and of. Y. Ozawa in two consecutive papers describe some species of the Foraminiferal family Polymorphinidæ found in the younger Tertiary formations of Japan, and give a revision of the family and its classification (*Japan. Jour. Geol. and Geog.*, vol. 6). The systematic paper abounds in new genera and species all carefully illustrated with clear figures. The classification of the family, far from being a simple problem, proves a complex one. The most primitive structure is met with in *Guttulina*; thence two main series are developed, one typically with the chambers more or less globular, the other typically with the chambers elongate. Further subdivisions follow dependent on the arrangement of the chambers, whether sigmoidal, biserial, or uniserial, as set forth in a table.

Chart of the Pacific.—The June issue of *Terrestrial Magnetism and Atmospheric Electricity* contains a summary by Commander J. P. Ault of the results obtained by the United States survey ship *Carnegie* during her voyage from Callao on the coast of Peru to Tahiti in the Society Islands during February and March of the present year. The depth soundings show the bottom to be very irregular, with a ridge 2000 metres above the general contour between Amanu and Hikuera Islands of the Tuamotu group, and a new deep, which has been named the Bauer deep, in Lat. 15° S., Long. 98° W. The compass deviation averages 10° E., the magnetic dip varies from zero off the coast of Peru to 30° S. near the Society Islands, and the horizontal component of the magnetic force from 0·30 to 0·33. There are five or six regions in which the British, German, and American charts show deviations of the compass which differ by half a degree or more from the *Carnegie* values.

New Model Microscope.—Messrs. C. Baker (244 High Holborn, W.C.1) have submitted for inspection an example of their B.L.M. microscope stand, which is a new model and embodies novel features. The limb is of rigid construction and carries a large body with rack-and-pinion coarse adjustment. A draw tube is provided, which may be graduated and have a rack-and-pinion movement fitted if desired. The fine adjustment is operated by milled heads on either side of the limb, is smooth and sensitive in action, and stops definitely at the end of the run. The instrument is quite stable in the horizontal position. The square stage, secured to the rigid bracket by screws and dowl pins, but easily removable so that other types may be substituted, measures $4\frac{1}{2}$ in. × $4\frac{1}{2}$ in., and has a clip for holding the slide which is moved by milled heads and has an amplitude of 70 mm. in the horizontal, and 30 mm. in the vertical, direction. The slide-clip is detachable in a moment by a very simple device, leaving the stage free and devoid of projections. The substage condenser is mounted on the limb, which thus forms practically an optical bench for alignment of the whole optical system, but can be swung out by pinching a spring and sliding downwards. The condenser, provided with centring screws, is held in its fitting by a thumb-screw, and so is easily removable; focusing is by rack and pinion, or in the cheapest model by a friction slide. The stand is exceptionally strong, rigid, and stable, and we can recommend the instrument as a thoroughly efficient one at a moderate price, for an outfit suitable for bacteriological work with rack-and-pinion focusing sub-stage with Abbe condenser, 2 eyepieces, and $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion (N.A. 1.3), objectives and triple nose-piece, costs only £31 10*s*. Stands of varying elaboration and price are listed.

The 'Fine Structure' Constant.—The issue of *Die Naturwissenschaften* for June 28 contains an article by Prof. A. Sommerfeld, in which he discusses inci-

dentally the question of the numerical value of the atomic constant α ($2\pi e^2/hc$). Prof. Sommerfeld attaches importance to the neat and satisfactory type of argument by means of which Prof. Eddington has indicated that $1/\alpha$ should have a value of 136, and points out in this connexion that it has been demonstrated repeatedly in the last twenty years that the most complete solution of a problem mathematically is often the one found in practice. Apart from this, however, he mentions that some recent American and Swedish measurements of X-ray wave-lengths with artificial gratings seem to show that Avogadro's number N should be changed to $5{\cdot}985 \times 10^{23}$, and hence, by combination of N with the electrochemical equivalent, the electronic charge e should be raised from $4{\cdot}77 \times 10^{-10}$ e.s.u., Millikan's value, to $4{\cdot}835 \times 10^{-10}$ e.s.u. $1/\alpha$ then becomes 135·9, which is almost identical with Eddington's number. It has to be remembered, nevertheless, that Prof. Millikan's value for e is based upon experiments the precision of which has never been seriously challenged, and that there is as yet no obvious internal evidence why it should be in error to the extent of more than one per cent. A very recent discussion of the X-ray data by J. A. Bearden in the June number of the *Proceedings of the National Academy of Sciences* (*U.S.A.*) shows that the value of $1/\alpha$ is more probably 136·6.

Synthesis of Cane Sugar.—Some doubt having been thrown on the synthesis of cane sugar recently effected by Pictet and Vogel, these authors have given in the June issue of the *Berichte* of the German Chemical Society very detailed experimental directions for the synthesis. It is clear that extraordinary precautions have to be taken to obtain successful results, and the failure of other experimenters, in the absence of these details, could readily be expected. It is necessary to follow precisely a definite method in each of the stages of the synthesis, involving the preparation of the γ-tetra-acetyl fructose, the condensation of the tetra-acetate of glucose and of the γ-fructose, the isolation of the octoacetate of cane sugar, and the saponification of the latter. The publication of these details, which were withheld in the first publication, will enable other chemists to repeat the work with more hope of success, and the reality of this important synthesis will no doubt be confirmed.

Action of Ammonia on Phosphorus Pentoxide.—In 1894, Baker found that dry ammonia was not absorbed by phosphorus pentoxide, and other experimenters have recently found that although a slight reaction occurs, at first, there is no further decrease in volume of the gas after forty-eight hours. In the July number of the *Journal of the American Chemical Society*, Harris and Wooster describe some careful experiments in which they show that there is really a very appreciable reaction between purified phosphorus pentoxide and ammonia gas prepared from the liquid dried over sodium and then fractionated. Although the reaction ceased before the pentoxide was saturated with ammonia, this was not due to cessation of the absorption on account of dryness of the gas, since absorption began again when a fresh surface of pentoxide was exposed. Previous results which seemed to indicate that no reaction took place are explained by the formation of a protective film over the pentoxide, a possibility which does not seem to have been reported by previous workers, whose results may have been influenced by it.

Water-cooled Furnace Walls.—The reduction of the number of all the electric power stations in Great Britain and the consequent increase in their size, and also the urgent necessity of obtaining the highest possible efficiency from the plant has led to some notable changes in boiler plant design. Higher and higher furnace temperatures are called for and the use of pre-heated air has become standard practice. The high temperatures make furnace repairs frequently necessary, and consequently lead to frequent stoppage of the boiler plant. This leads to an increased maintenance account and a direct loss of interest on capital. In a circular issued by Messrs. Babcock and Wilcox, Ltd., we learn that these troubles can be practically eliminated by using Bailey water-cooled furnace walls. These walls can be applied to all kinds of furnaces, whether used with stokers, pulverised coal firing, or oil firing. They issue two pamphlets, "Walls for Boiler Furnaces" and "Modern Boiler Plant Furnaces", which describe the advantages of the new furnace walls. This method, which cools all of the furnace walls to a moderate temperature, sounds better than having some part of the walls completely cooled by bare tubes, while other parts are of the usual brick construction.

Stiffness of Crankshafts.—A study of the rigidity of crankshafts is of importance to designers of marine engines, motor-car engines, and of aeroplane engines, and various investigations have been made with the view of evolving methods for calculating the stiffness of such shafts. One such investigation is the subject of *Report* No. 1201, by the Aeronautical Research Committee of the Air Ministry, entitled "On the Stiffness of Crankshafts". The author is Mr. H. Constant, and the tests made were carried out at the University of Cambridge and at the Royal Aircraft Establishment. The torsional resonance speed of an engine depends on the magnitude and distribution of its rotating and reciprocating masses and upon the effective torsional stiffness of its shaft, but this report is concerned only with the questions of stiffness involved. A number of crankshafts were subjected to static tortional tests out of bearings, and also in their crank cases, and from these a ratio of stiffness under the two conditions obtained. The conditions affecting this stiffening ratio were then investigated and a formula in terms of crankshaft dimensions evolved. A consideration of these results led finally to the application of a stiffness formula to the estimation of resonance speeds.

Fatigue Testing Machine.—A new high-speed fatigue testing machine is described by Mr. H. S. Rowell in *Engineering* for July 26. The primary object in designing the machine was the endurance testing of the plates of laminated springs such as are used in motor vehicles, while some of the considerations governing the design were: cheapness of construction, high speed of operation, ease of preparation of specimens, a considerable length of specimen to be under test, a wide range of stresses to be feasible. The ingenious way in which these objects have been attained is clearly shown by the description. Two springs are tested at the same time, each spring being held at four points by buckles of simple design with set screws. The two inner buckles are fixed, but the two outer ones, at the extremities of the test piece, are vibrated up and down by links connected to a gudgeon rod driven from a crank shaft. The total throw of the gudgeon rod is about $\frac{5}{8}$ in. The stress range is governed solely by the position of the buckles on the test piece and the throw of the gudgeon bar. Constructed of parts which are easily procurable, the machine is driven by an electric motor, while the balance is such that the need for foundations is eliminated. Three machines are at present in use having cranks of 0·25 in., 0·3125 in., and 0·375 in. radii respectively.

The Third British Empire Forestry Conference, 1928.[1]

THE third British Empire Forestry Conference was held in Australia and New Zealand last year, and the Summary Report, Resolutions, etc., of the conference have now been published.

The Conference assembled at Perth, West Australia, under the chairmanship of Lord Clinton, delegates from the Forest Services of the Empire and trade representatives being present. A procedure similar to that followed at the conferences of 1920 (Great Britain) and 1923 (Canada) was adopted. The itinerary included the six States of the Commonwealth and the North and South Islands of New Zealand. The Report gives evidence that a whole-hearted attempt was made to grapple with some of the great difficulties which face forestry in the British Empire, and indicates a fuller appreciation of those difficulties than was perhaps possible in 1920. This is exemplified by the address which opened the discussion on forest technique.

This address commenced with the statement, which is of the first importance that the Empire should thoroughly appreciate, that there is nothing mysterious in forest management, the principles of which differ in no radical way from those of a business or a farm. Commencing with a simple arrangement sufficient during the early stages of forest development, management became more elaborate with the increasing technique of operations and the increasing value of forest products, now becoming marketable. The preliminary work involved surveys and stock-taking, followed by a regulation of the yield to prevent the most common danger to existing forests, overcutting. The aeroplane was brought in to assist survey work, and its wider application was recommended under certain conditions.

Special reference was made to the effect on the permanency of forest industries by the regulation of the yield. Sylviculture, which is the foundation of true forest management, was then briefly dealt with, the various systems were discussed, and the modifications or adaptations which experience has shown to be necessary or advisable in certain types of tropical or temperate forests discussed. Natural regeneration, the conditions under which natural or artificial regeneration should be employed (Is it possible to lay down any hard-and-fast rule in this matter, apart from what the individual locality prescribes ?), and the value of mixtures were considered. In the case of afforestation in temperate climates, wide spacing was generally advocated in the case of fast-growing eucalypts and Douglas fir ; in South Africa, wide spacing (within limits) is said to reduce the costs of planting and weeding.

The total land area dealt with by the statements presented to the Conference is approximately 8,587,000 square miles, the total forest area, 1,910,000 square miles (in practically equal proportions of soft-woods and hard-woods), of which at present only 33 per cent is classed as merchantable. The area definitely dedicated to timber production is placed at about 4,250 square miles.

The progress made during the past five years is regarded as satisfactory and in some cases remarkable. It will be evident that in the parts of the Empire where forestry has been established on an organised basis for a considerable period, this progress will only be fully appreciable to the experienced professional forester ; whilst where the introduction of organised management is of more recent date, the advance made is far more striking from the public viewpoint. Thus, to quote the examples given, in Great Britain, South Africa, and New Zealand there has been a great increase in the rate of planting by government agency, the combined figures for the three countries being 89,000 acres in 1928 against 23,000 acres in 1923. New forest services have been constituted in British Guiana and Nova Scotia, and it is satisfactory to learn that others are contemplated. The statement is made, however, that "it is feared that some parts of the Empire are still oblivious to their obligations". It may be hoped that copies of this report will be submitted to the authorities concerned, for it should awaken them to a sense of their duty in forestry matters.

The discussions of the Conference embraced amongst other topics forest policy, Australian forestry, New Zealand forestry, education, Empire forestry bureaux and forest products research, labour in relation to forestry, climate and erosion, research in sylviculture, forest pests, fire protection, finance, utilisation, and experimental work with exotics. A few of these will be glanced at here, others being left for future consideration.

On forest policy the Conference was in some respects very sound. Emphasis was laid on the need for considering forestry in its national and imperial aspects, rather than as a simple matter of provincial or local concern. The view was advanced that central governments should take the lead in matters of policy, except where they are constitutionally precluded from so doing (it may be hoped that such instances will be very exceptional), laying down policy and taking control of legislation, general management, the alienation of reserved forest, the recruitment and training of superior staff, and research. Legislation might provide for the protection of water sources, prevention of erosion and shifting cultivation ; and in certain cases Government might assume, on conditions, the management of private forests in the public interest. The importance of making provision for local supplies of timber and fuel by the reservation or afforestation of areas near centres of consumption, including agricultural districts, was emphasised. In this connexion the importance of providing this type of forest produce might justify the utilisation of land fit for agriculture. It was correctly considered that local or communal forests should be under the management of trained officers working under a forest department, whatever might be the destination of the profits of working. The education of the public on the subject of the aims and utility of forest preservation was also discussed.

The lines upon which sylvicultural research work is now undertaken are fairly well known, and the Conference merely emphasised them ; the procedure evolved in India being the one adopted, so far as the Empire is concerned. The discussion on climate and erosion provided nothing fresh, but it paved the way for a consideration of the catchment area of the Murray River and its importance with reference to the Hume Weir.

Under finance, attention was directed to the fact that the indirect benefits from forests cannot be expressed in terms of money, though they are often greater and more vital than in other industries. "Forestry is such a long-tenure investment that, if compound interest is charged, there are no other comparable investments from which to determine the

[1] "Third British Empire Forestry Conference, Australia and New Zealand, 1928". (Government Printer, Canberra, Australia.)

rate." Many indirect benefits of the forest are well known, but even amongst the experts there was some difference of opinion as to what extent the indirect benefit argument should be used when such benefits cannot be assessed in definite terms. Compound interest should not be neglected altogether, but the rate should be below the current rate of money. It was argued in support of this contention that the national wealth does not in fact increase over long periods of time at a compound interest rate approaching 5 per cent, that forests increase automatically at compound interest, that they are a form of compulsory saving, and that the products of forests are independent of variations in the value of money—arguments which deserve to be more widely known and appreciated.

Finally, the Conference discussed the question of exotics. The need of careful experimental work before launching out on a large scale planting programme was emphasised. This warning is by no means a new one. In the past, however, a study of planting programmes furnishes evidence that each country has considered to a large degree that the warning does not apply to its own individual areas and work, the reiteration of the well-known dangers only applying to other parts of the Empire. The introduction of exotics usually (though by no means invariably) takes place when indigenous forests are lacking, when the indigenous species are of slow growth, or do not provide certain classes of timber essential to the country. "While suitable species should first be looked for in countries with similar climates, cases have occurred in which a species had been successfully introduced under climatic conditions quite different from those of its habitat." Therefore it was not possible to be dogmatic in this matter.

International Fisheries Investigations.

VOL. 49 of the *Rapports et Procès-Verbaux des Réunions*, Procès-Verbaux (Juin 1928), Conseil Permanent pour l'Exploration de la Mer (Copenhague: Andr. Fred. Høst et fils), shows abundant activity on the part of the various countries (now amounting to fifteen) involved in international fisheries work. The twenty-first re-union of the Council took place in Copenhagen in June 1928 under the presidency of Mr. H. G. Maurice. The reports and programmes of the area committees are mainly concerned with fishes, chiefly herring, plaice, cod, and haddock, expecially in the north-eastern and north-western areas, with sardine, hake, and tunny from the Atlantic Slope, salmon and sea-trout from the Baltic area, whilst special attention is given by the Hydrography Committee to salinities. An important memorandum is included with regard to plankton research. The old method of study by means of long tables with the comparative quantities of species present roughly noted is now almost universally abandoned, and exact quantitative methods substituted; the plankton is studied together with hydrographical data in connexion with the distribution of fish eggs and larvæ, and the results published in a special section of the *Bulletin Hydrographique*.

The report from the North-Eastern Area shows that more investigation has been done than ever before, Norway contributing oceanographical and plankton work, biological statistics of cod, sprat, and herring, and marking of cod, including a series of researches on the coast of More in close connexion with the whale fishery from the Whaling Station at Aukra, in which water and phytoplankton samples were taken besides zooplankton hauls, the laboratory at Aukra being busy the whole season in collecting observations on whales and the euphausiids which form their food. In the Lofoten and Finmark waters the plankton was in most places extremely meagre during the spring, the reason being (at any rate with regard to the phytoplankton) the scarcity of the nitrates and phosphates, which were almost totally absent from the upper water layers down to a depth of 50-100 metres, that is, throughout the whole thickness of the photozone, while very rich supplies were found in the deeper water. Stress is laid on the extreme importance to fishery research of the simplifications of method in investigating the fertilising substances, which were introduced by Atkins and Harvey of the Plymouth Marine Biological Laboratory.

The Consultative Committee welcomed the communications of the Danish Foreign Office on the intended agreement between Denmark and Germany relating to the regulating of fishing in the Western Baltic, and with regard to whaling an important point was the action of the Norwegian Government in communicating a draft bill for the extension of regulations now in force in the Falkland Islands and their dependencies to the pelagic whales which, up to this time, have been free from restrictions.

The arrangement of scientific meetings at these reunions is an innovation, the subjects of the first series being the estimation of nitrogen and phosphates in sea-water and racial investigations on food fishes (see NATURE, May 4, p. 697). It was recommended that the discussions for next year's general meeting should be on current measurements, direct and indirect, and fluctuations in the abundance in the stocks of food fishes.

University and Educational Intelligence.

THE American National Research Council's Information Service has recently issued two pamphlets—one on doctorates conferred in the sciences by American universities, and the other on funds available for the support and encouragement of research in science and technology. The former, an annual publication, gives the titles of all the 833 science doctorates conferred in 1927–28 classified under nineteen subject headings: chemistry, 269; zoology, 89; physics, 78; psychology, 66; botany, 61; mathematics, 44; geology, 35; agriculture, 31; pathology, 31; bacteriology, 29; engineering, 28; physiology, 28; seven other subjects, 44. The funds for research enumerated in the other pamphlet do not include those available for graduate scholarships and fellowships, particulars of which have been given in another publication (*Bulletin*, No. 38, 1923), but only those available for the encouragement and support of research in the form of medals, prizes, grants, or institutional funds. Of the 200 medals and prizes, 34 are for engineering subjects. Geography comes next with 8, and then astronomy and medicine, each with 7. Among organisations contributing to the advancement of science, Science Service (B and 21st Streets, Washington, D.C.) is noteworthy for its success in combining research and news activity, especially in its earthquake reporting service. In the fields of anthropology and archæology competent investigators are sent to alleged archæological finds, and reports made to Science Service for news purposes.

EDUCATIONAL broadcasting has been steadily developed by the British Broadcasting Corporation and now constitutes a very important part of its

vice. Recent developments in this field were the me of a paper read by Mr. H. Lynton Fletcher, of B.B.C., at a meeting of the Royal Society of Arts April 24 (*Jour. Roy. Soc. Arts*, July 19). In October 26 a joint committee of the British Institute of ult Education and the B.B.C. was set up under the irmanship of Sir Henry Hadow. The report of s committee, signed on Mar. 15, 1928, and published der the title of "New Ventures in Broadcasting", ggested the establishment not only of a national tral council for broadcast adult education, but also to take charge of broadcasting to schools. The o councils thus suggested have been established h wide powers of direction and control. Meanile, for the purpose of dealing with technical blems, the B.B.C. has maintained since 1926 a ff of 'education engineers', now numbering fourn, who advise on the improvement or construction receiving sets, answer teachers' inquiries about the ms of educational broadcasting, and collect and s on to the sections of the B.B.C.'s education partment concerned information regarding school ditions and teachers' suggestions, criticisms, and ficulties. The number of schools visited by request 928 was 2276. Specifications for one, two, three, four-valve sets suitable for use in schools and adult education organisations have been drawn and are available free of charge to all who are cerned with the work. Mr. Fletcher's survey ludes a lucid exposition of principles, and conutes, with the record of the discussion which owed the reading of his paper, a valuable conbution to the literature of educational broadting.

N "Major Trends of Education in other Countries" ashington, D.C.: Government Printing Office, pp. price 10 cents), the specialist in foreign education he United States Bureau of Education presents a est of recent educational statistics and reviews the ivities of educational institutions in all other parts the world. For higher education there were blished between 1920 and 1926 more than 150 bodies: of the usual university type, 15; distinctly ntific in purpose, 55; concerned with sociology pedagogy 24, health 20, agriculture 9, commerce 7. mmaries are given of some recent developments in versity education in France, Germany, Greece, ly, Palestine, Russia, China, and India. Secondary cation has, says the review, exhibited five general dencies since the War: to become more easily essible to capable children of poor parents, to tpone determination of later careers, to facilitate nsition between parallel courses, to incorporate the nical and vocational schools more closely into general school system, and to prolong compulsory ool attendance: recent developments in Austria, ssia, France, and England are summarised. In section relating to elementary education, attention irected to the very general prevalence in Europe sentiment in favour of the practical and concrete pposed to mere verbal knowledge, and a belief in theory that the school should provide scope for spontaneous activity of the child, the teacher ng an adviser rather than a disciplinarian. The lication of these ideas is carried to extreme lengths he work schools now common in Russia, where t of the activities are controlled by the pupil, no e of grading is used, and the school certificate es that the pupil has "studied and learnt to ly" the subjects mentioned in it: their influence raced in recent changes in Austria, France, Italy, nd, England, and New Zealand.

Calendar of Patent Records.

August 25, 1810.—The modern food-preserving industry is based on the process of sterilisation by means of heat in hermetically sealed containers invented by Nicholas Appert, for which an English patent was granted in the name of Peter Durand on Aug. 25, 1810. No French patent was issued for the invention, but as in the case of Daguerre, the value of Appert's process was recognised by the French government, and he received a grant of 12,000 francs in lieu of a patent. Appert published a description of the process in his book "Le livre de tous les ménages" in 1810, which ran into several editions and was translated into English in 1811.

August 26, 1825.—On Aug. 26, 1825, was enrolled the specification of the patent granted to Cornelius Whitehouse for the manufacture of iron tubes for gas and other purposes, which laid the foundation of the welded iron-tube industry. The process revolutionised the trade, the tubing being much stronger and more uniform, and the cost of production being reduced to about one-half. The patent, which was assigned to James Russell, Whitehouse's employer, was assailed in the courts, but on every occasion was upheld, and was finally extended for six years, one of the conditions of the extension being that Whitehouse was to receive an annuity of £500.

August 26, 1856.—Mauve, the first of the aniline dyes to be discovered, was patented by Sir William Henry Perkin on Aug. 26, 1856, and the commercial production of the new dyestuff was started the following year in a factory at Greenford Green, near Sudbury. The discovery gave a great stimulus to the study of organic chemistry, and the factory at Greenford and other establishments started in England continued to flourish with the ever-increasing production of new colours. When Perkin retired in 1874 to devote himself to research, the industry was well able to hold its own, but the position was not maintained for long in the face of foreign competition.

August 27, 1841.—The patent granted to H. W. Jenkins, manufacturer of Worcestershire, on Aug. 27, 1841, describes a machine for inserting pins into the crinkled paper holders in which they are sold. The pins drop from a hopper on to a grooved plate, so that a pin is deposited in each groove. The paper is hung over a ribbed bar in front of the plate and grooved transversely to correspond, and is crinkled by means of a second bar pressed down on to it. Whilst the paper is so held, the pins in the grooves are pushed through the folds of the paper, and the operation is repeated in another part of the sheet.

August 29, 1799.—The D-shaped slide-valve which is the most common form of valve employed for steam-engine cylinders, was patented by William Murdoch on Aug. 29, 1799.

Aug. 30, 1881.—A forerunner of the wireless broadcasting of to-day was the electrophone, in which music and dramatic performances were regularly transmitted over the ordinary telephone wires from selected theatres and concert-halls to special subscribers. The most generally used transmitter for this service was that invented by Clement Ader of Paris and patented by him in Germany on Aug. 30, 1881. French and English patents were issued the same year.

August 31, 1830.—One of the earliest successful patents for a railway-carriage wheel was that granted to William Losh on Aug. 31, 1830. Wrought-iron spokes, which were cast into the cast-iron nave, had elbow bends and curved prolongations which were joined one to another to form the circular rim of the wheel, on to which the wrought-iron tire was directly shrunk.

Societies and Academies.

PARIS.

Academy of Sciences, July 17.—S. Drzewiecki: The determination of the velocity of sound, based on the kinetic theory of gases.—Marcel Picard: A method for the determination of the ohm in absolute units.—Jean Becquerel: Introduction to a theory of the magnetic phenomena in crystals.—Edgar Auber de la Rue: The geological constitution of Heard Island.—B. N. Zolotarevski: The behaviour of *Locusta migratoria*, subsp. *migratorioides*.—L. Lutz: The soluble ferments secreted by the Hymenomycetes. Comparison of the anti-oxygen power of tannin and the phenolic constituents of the essential oils.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 8).—V. Mitkevic: Anomalous magnetic flux of a toroidal coil. (1) The case of a closed iron screen. Continuation of the investigations reported upon in previous papers by the author. The phenomena observed are easily explained on the basis of Faraday's views concerning the magnetic field.—G. V. Pfeiffer: Theorems elucidating a series of questions in the problem of the permutation of solutions of a linear equation with partial derivatives of the first order.—A. Tolmačev: The expedition of the Academy of Sciences to the Taymyr peninsula. The expedition lasted about a year and resulted in the discovery of several previously unknown mountain ridges, numerous other corrections in the map of the peninsula and in collections of its flora and fauna.—A. N. Ivanov and A. Tsvetkov: Spontaneous movements of daphnias. Spontaneous movements of daphnias were studied by the authors in comparison with the Brownian movements of particles and a very close correlation has been found.—P. Schmidt: The occurrence of the eel, *Uroconger lepturus* Richardson, in Japan. The species is widely spread in the Indian Ocean, being recorded from India, Sumatra, Java, Celebes, and the China Sea. Bleeker recorded it from Nagasaki, and the author found it in Kagoshima. Southern Japan is probably the northernmost limit of its distribution. A redescription of the species, with illustrations, is given.—P. Schmidt: *Hoplosebastes armatus*, a new genus and new species of the family Scorpænidæ from Japan. The genus is related to *Neosebastes* Guich., but differs in the absence of teeth on the palatines and in the strongly armed head; it is described from a single specimen taken at Nagasaki.—A. Mordvilko: Anolocyclic elm aphids *Eriosomea* and the distribution of elms during the tertiary and glacial periods. Species of the four genera belonging to the group *Eriosomea* live on *Ulmus spp.* and migrate to other plants. The migrants of some species are found in the areas where there are no elms at present, for example, in Africa, suggesting that these trees existed there at some former geological period.

SYDNEY.

Linnean Society of New South Wales, April 24.—G. H. Hardy: On the type locality of certain flies described by Macquart in "Diptères Exotiques, Supplement 4". About 140 species of flies are described by Macquart as from Tasmania in this work. It has long been known that the locality is erroneous in several cases; close study has indicated that many other species may also be wrongly localised, and it is a question whether all or practically all may not have come from Sydney and not from Tasmania. By making this change in location, the identity of many outstanding species may be ascertained.—G. H. Hardy: Notes on the identity of described Australia flies of the genus *Cerdistus* (Asilidæ). The descrip tions of some of these flies, described by Macqua as from Tasmania, agree with species from the mai land, and not with those that occur in that islan This amendment in location has enabled the adjus ment of synonymy hitherto unsuspected.—J. Malloch: Notes on Australian Diptera (19). Pr sents notes on some of the Tachinidæ describing new four species of *Hyalomyia* and one species *Actia*.—H. J. Carter: Australian Coleoptera. Not and new species (6). Describes as new one speci of Lucanidæ, four of Buprestidæ, one of Dasci lidæ, six of Tenebrionidæ, two of Cistelidæ, and tw of Cerambycidæ. Notes are given on synonymy a number of species of *Stigmodera* and a revised key presented for the species of *Hybrenia*.—G. P. Whitley Fishes from Ongtong Java, Melanesia. A list is give of species of fish recently collected at Ongtong Jav Macleay's species, *Pseudupeneus filamentus*, is r described and referred to a new subgenus.—W. Waterhouse: A preliminary account of the origin two new Australian physiologic forms of *Puccini graminis tritici*. Several definite physiological form of wheat stem rust have been determined fro Australian uredospore material during the past eig years. In the spring of 1928, inoculation of barberri with teleutospores of (1) *Puccinia graminis tritici* and (2) a mixture of *P. graminis tritici* 34 and 43 ga rise to the spermagonial and æcidial stages in (1), an to the spermagonial stage in (2). Following upo spermatial intermixing of (1) and (2), from (1) we derived cultures of Forms 11 and 34, and from (2) new form otherwise unrecorded. Form 11 and th new form have not been found on any other occasio during the investigation.

Official Publications Received.

BRITISH.

Indian Central Cotton Committee: Technological Laboratory. Bulle No. 18, Technological Series No. 13: Ginning Percentage and Lint Ind of Cotton in relation to the Number of Cotton Fibres per Seed; the Eff of Environment on Ginning Percentage and the Determination of U Fibre-Weight. By A. James Turner. Pp. ii+41. (Bombay.) 1 rupe

Journal of the Royal Statistical Society. New Series, Vol. 92, Part Pp. viii+321-485. (London.) 7s. 6d.

Proceedings of the Geologists' Association. Edited by A. K. Wel Vol. 40, Part 2, 19th July. Pp. 105-196+plates 5-14. (London: Edwa Stanford, Ltd.) 5s.

The Journal of the Royal Anthropological Institute of Great Brit and Ireland. Vol. 59, January to June 1929. Pp. 272+23 plat (London.) 15s. net.

The Chadwick Trust: a Short Account of its Founder, its Objects a its Work. Second revision. Pp. 28. (London.)

FOREIGN.

Meddelanden från Statens Meteorologisk-Hydrografiska Ansta Band 4, No. 8: De svenska vattendragens arealförhållenden. 7: Lijung och Lijusman M.FL. (Flodområdena n:ris 42-48.) Av Gustaf Wers Pp. 16. 1.50 kr. Band 4, No. 5: Kartor över vattenmängden o sjoprocenten i sverige. Av Gustaf Slettenmark. Pp. 7+4 kartor. 1 kr. (Stockholm.)

Abisko Naturvetenskapliga Station. Observations météorologique Abisko en 1928. Redigées par Bruno Wolf. Pp. iv+66. (Stockholm

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 8, 1926. Meteorologiska iakttagelser i sverige, Band 68. Pp. x+177. (Sto holm.) 7.00 kr.

Diary of Societies.

CONGRESS.

AUGUST 31 TO SEPTEMBER 6.

NATIONAL VETERINARY MEDICAL ASSOCIATION (at Ayr).—The papers to read include the following:—Foot-and-mouth Disease, J. O. Powle Lameness, Prof. J. J. O'Connor; The Mineral Requirements of Fa Animals, Dr. J. B. Orr; Johne's Disease, Major G. W. Dunkin; T Clinical and Epidemiological Aspect of the so-called Hysteria of t Dog, Prof. F. T. G. Hobday.

On Sept. 3 at 1.45 a Popular Public Lecture on Tuberculin Testi by Prof. J. B. Buxton.

Public Library

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A State Scientific Service.

WE are justly proud in Great Britain of the esteem in which our Civil Service is held throughout the world; and although opinion may differ on the sagacity of the various political chiefs who temporarily influence it or are influenced by it, the reputation of its permanent chiefs is unquestioned. To them are attributed sagacity, foresight, breadth of outlook, incorruptibility, and those other qualities associated with high intellectual ability and respect for the Civil Service ideals and traditions. Their responsibility is enormous. The machine of government which they control is almost bewilderingly complex. Upon their knowledge of its parts and appreciation of its respective functions, their receptivity of new ideas, their capacity to develop the machine to cope with its ever-increasing tasks, upon their judgment of its personnel, the smooth working of the Service depends.

Probably no civil servants are more appreciative of the nature of the responsibilities of the permanent administrative heads of the Civil Service than scientific workers. They realise that they themselves comprise a comparatively new element in the government machine, that the machine as originally designed and constructed took little account of their introduction as an integral working part. They realise that in many cases their introduction has been in the nature of an experiment in State-craft. Their immediate preoccupation has been to justify the experiment. Those creative energies identified with scientific training and outlook have found new scope in the service of the State, and have given the State more intimate contact with the activities of the peoples whose destiny it controls. Until comparatively recent years, moreover, State scientific workers were left comparatively free from what may be called 'lay' administrative interference. Consequently, as a class, they exhibited little of that impatience with their material and other conditions of service which is usually associated with State servants. Unfortunately, the heads of the Treasury appear to have interpreted their patience as a proof of their contentment with their position in the service.

When the Civil Service National Whitley Council was constituted its first task was to consider the reorganisation of the Civil Service and the adjustment of pay and other conditions of service of civil servants to standards approximating to those of persons with equivalent qualifications and responsibilities outside. The position of the clerical and executive officers of the service was greatly

improved as the result of the recommendations contained in the report of the Whitley Council, and that of administrative officers, although not specifically dealt with in the report, was improved also. But for some reason the Council did not consider at the same time the claims of scientific and technical grades for improved conditions.

It was some time before the representatives of the Institution of Professional Civil Servants on the National Whitley Council managed to obtain any consideration for these grades. It was urged by the Official Side that the Heath Committee had really done all that was necessary to adjust the emoluments and status of the scientific grades to those of others. Eventually, in 1922, a sub-committee of the National Whitley Council was set up to deal with certain groups of scientific officers. But scientific workers in what was regarded as 'research' establishments, according to the terms of reference, were not included in the inquiry. This was unfortunate, as it prevented scientific workers in the Civil Service being considered as a unit. It created the impression that an attempt was being made to differentiate arbitrarily between the scientific officers in different departments, to define arbitrarily the functions of the personnel. This impression was re-inforced by the findings of the sub-committee and the scales of salary it recommended. What was even worse, the official members of this sub-committee refused to regard the duties of the scientific groups which they had under consideration as comparable in any way with the administrative group in the Civil Service.

In the year 1923, in response to a clamour in the Press, another committee was set up to report on the pay of State servants. This committee, which was presided over by Sir Alan Anderson, found abundant reasons in every case for leaving things alone. It did not consider the pay of administrative officers excessive. On the other hand, it saw no reason why it should be equated to that of men holding high administrative posts outside the Service. It saw no reason why the salaries of the scientific personnel should be increased, because the scales of pay attracted candidates of sufficient quality. But what offended scientific officers more than anything else was its reply to the suggestion "that the efficiency of those departments which control a large number of technical officers is lowered and prospects of promotion impaired by the practice of appointing a non-professional head". On this the Anderson Committee expressed the opinion that "the head of a department should be so detached from technical bias that he can weigh the advice of his various officers and judge correctly between competing claims, each of which may, to its technical advocate, seem to be paramount". It went further and said: "There is a danger that if a man is appointed head of a Department because of his technical qualifications, he may not be able to free himself from his technical outlook and that the Service may not gain, but suffer, by his special knowledge in one direction".

This pronouncement was regarded, rightly or wrongly, as an expression of the opinion of the administrative heads of the Civil Service. It gave offence because it apparently assumed that scientific officers as a class, by reason of their training, special knowledge and experience, were less likely to produce men not only capable of assuming administrative control over Departments with the work of which they were thoroughly familiar, but also able to relate the activities of such a Department with those of other Departments of State—in other words, scientific officers as a class were men whose judgment was warped by their special knowledge. The hope then, which had been cherished by a large number of scientific officers, that the day was approaching when the administrative heads of the State machine would realise the need for the creation of a Ministry of Science, the administration of which would be entrusted to fully qualified scientific workers, the director of which would have immediate access to the political head of the Department, appeared to be frustrated.

Since the publication of the Anderson Committee Report in 1923, the two bodies which can be said to be almost fully representative of the scientific personnel in the Civil Service, namely, the Institution of Professional Civil Servants and the Association of Scientific Workers, have given further consideration in concert to this far-reaching question of the relationship of the scientific worker to the State machine. After deliberation they decided to press again the Civil Service National Whitley Council to set up a committee of inquiry to embrace the whole of the scientific personnel of the State. The Official Side of the National Council yielded sufficiently to their pressure to agree to the appointment of a Treasury Committee of Inquiry into the organisation and staffing of research and experimental establishments under the chairmanship of Sir Harold Carpenter. As announced in NATURE of Aug. 3, the Institution of Professional Civil Servants gave evidence before this Committee.

The preliminary statement of evidence submitted to the Committee of Inquiry by the Institution is

orthy of careful study by all classes of scientific orkers whether in State or other employ. Its presentatives state :

"There is a considerable body of scientific inion within the Institution which considers that e only finally satisfactory resolution of the defects ising from the sporadic growth of the State ientific services must be attained by the co-dination of all branches of scientific research and periment into a unified State Scientific Service. ne conception of a Ministry of Science is a very d one, suspect through the excesses of romancers, nd inviting the facile labels 'visionary' and topian'! While the details of the scheme are ill under discussion, the outline is sufficiently finite for it to be urged that the proposal, sionary or not, is immediately 'practical politics'. nat there are difficulties of definition, delimita-on, organisation, and liaison to be faced is fully cognised, but the gains in effective and economical orking which would result are such as to justify ne most drastic reorganisation."

The deputation further asked that recruitment the scientific personnel for the Civil Service ould be placed on a more systematic and satis-ctory basis. The system under which candidates r the diplomatic service are chosen is one which broad outline commends itself apparently to the nstitution. Certain modifications in the system ill obviously suggest themselves. It would be nnecessary, for example, to submit men who have ready taken a good honours degree at one of the cognised universities to a further examination. hey could be selected as probationers for the ervice on the results of their degree examination nd their general record. Once they were appointed s probationers, they could be given a further study eriod to prove their capacity for research or chnical development, and afterwards drafted to ientific departments, the requirements of which resumably could be made known well in advance. he creation of a *corps d'élite* for science would e the natural corollary.

There is much else that is interesting in the state-ent submitted by the Institution, but these are s revolutionary proposals. It can be said that ey are such as to merit the closest attention of the ientific world. If adopted by the State, they ould probably go far to remove the growing ntagonism between the majority of State scientific orkers and the administration. If a Ministry of cience were created the State would be enabled offer an honourable career to men trained in ience and attract the very best brains to its rvice. The findings of the Carpenter Committee ill be awaited with the greatest interest.

Economic Entomology.

(1) *The Problems of Applied Entomology.* By Prof. Robert A. Wardle. Pp. xii + 587 + 4 plates. (Publications of the University of Manchester, No. 191 : Biological Series No. 5.) (Manchester : Manchester University Press ; London : Longmans, Green and Co., Ltd., 1929.) 30*s.* net.

(2) *The Principles of Applied Zoology.* By Prof. Robert A. Wardle. Pp. xii + 427. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1929.) 21*s.* net.

(3) *Destructive and Useful Insects : their Habits and Control.* By Prof. C. L. Metcalf and W. P. Flint. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xii + 918. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1928.) 37*s.* 6*d.* net.

PERHAPS in no branch of science have greater developments occurred in the last half-century than in the realm of economic entomology. Since the pioneer days of Miss E. Ormerod and her co-workers, there has been a prominent change of attitude towards the subject on the part of economic entomologists, which has resulted in a corresponding change of attitude of academic entomologists towards workers in the applied field. Though the work of the entomologist will always be primarily that of observing the living animal in all its activities, more and more is he finding it necessary to attack his problems by the use of methods employed by his colleagues of cognate sciences. The greatest qualitative development of the subject has resulted from this invasion of chemistry, physics, and botany. Thus the chemist and physicist investigate in detail the effect of insecticide on plant and animal, and the botanical aspect is expressed in a determination of the effect of the insect on plant physiology. The most recent development lies in the hands of the mathematician, embodying for the most part attempts to measure the intensity of insect infection before and after treatment. It is because of this active co-operation that the economic entomologist is no longer regarded as a dabbler in science, but one who awaits and welcomes active collaboration with chemists, physicists, and botanists. Such collaboration does exist, and is resulting in the establishment of a sound scientific foundation.

Treatises on economic entomology are written with different ends in view—to serve the student, lecturer, adviser, or agriculturist. In the books under review we have happily two widely different presentations. Prof. Wardle in general deals with

principles, and therefore caters for the academically minded. Messrs. Metcalf and Flint are here to help the man in the field, whether he be farmer or entomologist; giving at the same time assistance to the student during his course of instruction.

(1) Prof. Wardle is well known as the senior author of that excellent book, "The Principles of Insect Control", by Wardle and Buckle (1923). One outstanding fact emerges from reading his new book, namely, that empiricism, almost inseparably bound to all applied branches of science, is quickly being replaced by science in the proper sense of the word. That entomologists are alive to the need for co-operation with chemists, physicists, and botanists is shown by the first chapters in the book, dealing with such problems as host and climatic resistance, tropic behaviour, and insecticides. Instead of merely accumulating facts on what insects do, more and more is the war being carried into the enemies' camp by finding the reason for their actions.

The influences of climate on distribution in space and of weather on distribution in time are well reviewed, while in the summary of work on tropic behaviour, the importance of further researches into insect tropisms in all stages of the life cycle is rightly pointed out. Biological, chemical, and cultural control are subjects which bring the first part of the book to a conclusion. This first part of 247 pages is supplementary to "The Principles of Insect Control", and therefore only deals with literature which has appeared since 1922.

The second part is of great value, bringing together for the first time the problems which confront entomologists in all parts of the world. For this purpose two areas are recognised, that of ancient and that of modern agricultural practice. The areas of ancient practice—those following the small plot system—it is suggested, are free from major pests except where the plantation system of cultivation has been introduced. Modern agricultural methods mass insects' food media together, tend to remove competition from certain insect types, and enable them to increase in numbers and so acquire the status of pests. Geographical barriers to distribution are removed by the agency of man under civilisation, and the spread of insects from endemic areas is thereby facilitated. These are the fundamental factors underlying the outbreaks of the most serious insect pests. The main problems of the several areas are then dealt with from both the agricultural and medico-veterinary points of view, reference being freely made to the third part of the book, which consists of a copious bibliography o about forty pages.

One would like to see each chapter of thi excellent book enlarged to book form. It is a boo which ought to be in the possession of ever entomologist. In both of Prof. Wardle's book under review the author shows that he has a extraordinary grasp of the research front of th field of economic entomology.

(2) In the second book from Prof. Wardle's pe a glance at the parts into which it is divided lead one to assume that the author has attempted a impossible task. To condense into four hundre pages medico-veterinary, agricultural, and horti cultural aspects of zoology, and a part dealing wit animal industries, is a big order. One soon finds however, that the author is master of the art o abstracting the part that matters from lengthy papers without sacrificing interest. There is a lucid account of the main protozoa associated wit man and domesticated animals. Perhaps it i here, and here alone, that the information appear in tabloid form. Elsewhere, as for example in th chapters dealing with helminthes and arthropods the interest of the reader is well sustained. Life histories are readably summarised, and in the cas of helminthes, methods of diagnosis with descrip tions of the main types of eggs are given. The entomological bias of the author appears in hi excellent treatment of the chapters on arthropods Relation to disease, categories of insect pests, th conditions which govern the length of life cycle behaviour, and mortality of insects are treated i a refreshingly broad manner.

For the rest, the student who wants to know something of breeds of cattle, and animal indus tries from bee-keeping to whaling, will find it in thi book. A book of such scope and so well-writte will be read with equal profit by students of zoology and agriculture alike. To the diploma student o agricultural zoology it supplies a much-felt want.

A copious bibliography of twenty-seven page is appended, to which the author might hav referred more specifically.

(3) The authors of "Destructive and Usefu Insects", one an experienced teacher, the other a practical entomologist, present us with a well balanced book. It is essentially a book for th practical man, a guide for the farmer, gardener and adviser. Theoretical considerations are re duced to a minimum, and practicability is expresse in brief life histories and advice on the method o control applicable to each case. The elements o insect morphology, physiology, development an

ystematics occupy the first part of the book. ere the morphologist will disagree with the atements that eyes are specialised appendages of head segment and that the labrum belongs to e third head segment, but the purpose for which e book was written greatly minimises the gravity these errors. Insects' mouth parts are clearly d simply explained, and the use which is made of e success of insects in the struggle for existence, a peg on which to hang the account of morpho- gy, is admirable.

The field entomologist is obviously responsible r the next part of the book dealing with insect ntrol and the main insect pests of the United ates and southern Canada. Accompanying about ty pages dealing with insecticides and appa- tus for their application, we find one page and half devoted to the subject of biological ntrol—obviously too little in a book of some ne hundred pages.

An orderly arrangement of insects according to e crops or products they attack follows. For ch category the authors have inserted a most luable field key for diagnosing the pest by the rm of damage suffered by the particular com- odity, and for each insect the type of injury, stribution, life history, and control measures are early given. There is a limited number of litera- re references, but these are well chosen, consisting standard text-books or easily accessible entomo- gical publications. The book is well written, and ustrated with 561 figures ; it should have a good ception, especially from American entomologists d agriculturists. L. Eastham.

Modern Sea-Urchins and their Origin.

Monograph of the Echinoidea. 1 : *Cidaroidea.* By Dr. Th. Mortensen. Text : Pp. v + 551. Plates : Pp. 24 + 88 plates. (Published at the Expense of the Carlsberg Fund.) (Copenhagen : C. A. Reitzel ; London : Oxford University Press, 1928.) 2 vols., 100*s*.

ALL students of both Recent and extinct sea-urchins must be glad that so high an authority these animals as Dr. Mortensen of Copenhagen also an audacious optimist. Without that quality would scarcely have proposed to write "A onograph of the Echinoidea", of which the first ction, dealing with but a single family, runs to 1 pages in super-royal quarto and 88 plates. rtunately, pecuniary assistance by the Danish vernment enabled the author to pursue his task thout distraction, while grants from the Carlsberg Fund assisted the necessary journeys and the preparation of the plates. The task, moreover, is not quite so enormous as the title implies, for it is only Recent species that are described in detail. None the less, the numerous extinct genera are adequately discussed and figures of characteristic species are provided, so that the necessary foundation is laid for the systematic superstructure.

There are two aspects of such systematic work : the broad plan, and the treatment of details. The plan of the classification of any Recent group of animals should, according to modern principles, be determined by the ancestry. There are two contrasting hypotheses of the early history of the Echinoidea. Dr. R. T. Jackson, the monographer of the palæozoic echinoids, so many of which have numerous columns of plates in both radial and inter-radial areas, believes that all arose from such a simple form as the Ordovician *Bothriocidaris*, with its two columns in each ambulacrum and single column in each interambulacrum. Dr. Mortensen, more familiar with genera in which only two columns in each area is the rule, seeks the ancestor in some many-plated form from which the post-palæozoic genera have been derived by reduction of plates. To make this view plausible, he has had to get rid of *Bothriocidaris*, which he regards as probably an offshoot from Cystidea Diploporita. It is interesting to note that similar conflicts of opinion obtain concerning both Asteroidea and Crinoidea, and the solution will probably be of the same nature for each class.

The idea that the Echinoidea (and Asteroidea) are derived from some ancient Edrioasteroid type is gaining general acceptance, and Dr. Mortensen is not the first to cast doubts on the echinoid nature of *Bothriocidaris*. Unfortunately, his recent study of its fossil remains is not so convincing as one had hoped ; but, even if *Bothriocidaris* be an echinoid, it may just as well be specialised as ancestral. A many-plated echinoid was its contemporary. On the other hand, the regular growth of the columns in many-plated forms favours Jackson's view of a progressive increase in the number. Assuming, then, an Edrioasteroid ancestor, one may imagine the change to an echinoid as accompanied by a speedy regularisation of the inter-radial plates into two columns. From this norm subsequent *plus* or *minus* deviations may have arisen.

Dr. Mortensen would derive the Cidaroids from the Archæocidaridæ by reduction of columns, and the Diademoids from the Lepidocentrids. In the Echinoidea, as in some other groups, many branches

withered at the close of palæozoic time, and mesozoic life burgeoned afresh from very few twigs. Those twigs one would expect to be unspecialised forms. While, therefore, the grouping of the Cidaridæ with the 4-columned Archæocidaridæ seems natural, some obscure Carboniferous and Permian fossils may really be in a more direct ancestral line of 2-columned genera. The further possibility, that the Diademoids were derived from Cidaroids, is not discussed by Dr. Mortensen.

Restricting attention now to the Cidaroids, we find Dr. Mortensen placing all post-palæozoic genera in the single family Cidaridæ. He discusses the possible separation of those early genera in which the test was still flexible with bevelled imbricating sutures, but rightly decides that the gradual change to rigidity along many lines precludes a family grouping. Of those characters on which he does rely for family and generic diagnosis, Dr. Mortensen gives an admirably lucid account. Among other features utilised is the microscopic structure of the cortex of the radioles. On well-preserved recent specimens this often bears long delicate extensions of stereom; these, which the author rather infelicitously terms 'hairs', have diagnostic value. From Lovén onwards, students of Echinoidea have attached importance to the supposed streaming of the ambulacral plates downwards on to the membrane round the mouth. Dr. Mortensen believes that the appearance is due merely to the growth of this area by resorption of the interambulacrals. Neither here nor elsewhere does Dr. Mortensen mention the great name of Lovén: the omission is astounding.

Many of the characters utilised by Dr. Mortensen are not preserved in fossils, but this regrettable fact does not prove his method unsound. The ultimate classification will, however, have to take extinct forms into account, and palæontologists must seek, in those parts of the skeleton that are preserved for them, microscopic structures no less characteristic than pedicellariæ and more widely applicable.

In presentation of results, whether by word or picture, Dr. Mortensen's work takes high rank. Its technical excellence justifies the strength of his protest against the disorderly descriptive writing still too common, and against the half-tone reproduction of obscure photographs, both of which methods leave the reader to do the scientific work for himself. As a clear compendium of results scattered through publications both large and small throughout the world, this monograph will be welcome in every zoological library.

F. A. BATHER.

Mechanics and Acoustics.

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer, E. Waetzmann. In 5 Bänden. Band 1: *Mechanik und Akustik.* Teil 1: *Mechanik punktförmiger Massen und starrer Körper.* Herausgegeben von Erich Waetzmann. Pp. xvi + 848 + xii. Teil 2: *Elastizität und Mechanik der Flüssigkeiten und Gase.* Herausgegeben von Erich Waetzmann. Pp. viii + 849 – 1258. 75 gold marks. Teil 3: *Akustik.* Bearbeitet von Erich Waetzmann. Pp. xii + 484. 29 gold marks. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.)

IN view of the recent important additions to the literature of physics contributed by German writers, it is natural to pause and inquire what precisely is the difference between a 'Handbuch' and a 'Lehrbuch'. It appears to the reviewer, particularly from a consideration of the books now before him, that the answer to this inquiry is very simple. The former is designed to satisfy the needs of the research worker who requires the most detailed information upon any of the special branches of physics with which he is intimately concerned, whilst the latter is designed to meet the demands of a busy teacher of physics who only requires accurate information upon the fundamentals of the whole of those branches of physics upon which he may be expected to lecture.

Now the books under review form the first volume of the eleventh German edition of Müller-Pouillets' "Lehrbuch der Physik". There is clearly no need, then, to discuss whether this particular 'Lehrbuch' satisfies the demands of teachers of physics. It only remains to decide whether these portions of the latest edition present an up-to-date account of the branches of physics with which they deal. On this point we are quickly satisfied.

Turning to Part 1, on the mechanics of particles and of rigid bodies, we find that it has been entirely rewritten. It opens with an excellent introduction to physical concepts written by G. Mie. This is followed by a comprehensive section on the measurement of length, mass and intervals of time, by G. Berndt. Dimensional formulæ are treated by H. Dieselhorst, and Newtonian mechanics by E. Madelung and W. Thomas. The mechanics of particles are also dealt with by H. Dieselhorst, and the mechanics of rigid bodies by W. Hort, who might with advantage have included a fuller statement of the errors to which pendulum measurements are open. Gyroscopic motion, including

astronomical and geophysical examples, is treated by M. Schuler.

Part 2 deals with the mechanics of liquids and gases, and is particularly noteworthy for the masterly treatment of the motion of liquids and gases by L. Prandtl. It is really unfortunate that Part 2 cannot be separately purchased, and it is not too much to say that this excellent section ought to be rendered accessible to a wider circle of readers by translation into English. Other interesting features are sections on the rupture of materials by T. Pöschl, and on the preparation and properties of single metal crystals by P. Ewald.

Part 3, on sound, has also been almost entirely rewritten, only two sections from the tenth edition being used in their entirety. It contains an excellent account of modern electrical methods of measurement and analysis of sound waves, and of modern work on acoustics of buildings.

It should be added that references are everywhere freely given, in many cases work carried out in 1928 being mentioned, so that the whole volume may confidently be recommended to the attention of English physicists.

Theoretical Mechanics.

The Principles of Mechanics : an Elementary Course. By Prof. H. C. Plummer. Pp. xii + 307. (London : G. Bell and Sons, Ltd., 1929.) 15*s.* net.

FOR the student beginning theoretical mechanics a treatment based entirely on Newton's laws of motion seems to be not only desirable but also absolutely necessary if a sound basis on which further development may rest is to be assured. At the outset the reduction to mathematical form of the problems of mechanics has to be faced, and this proves as a rule to be the greatest stumbling-block ; the subsequent mathematical treatment appears in the main to offer much less difficulty than the original formulation. The reason for this difficulty in formulation is generally traceable to two causes : (1) an insufficient appreciation of the simplifying assumptions in the external conditions which must be made in order to render the problem manageable; (2) an inadequate grasp of the mechanical principles contained in Newton's laws. To overcome (1) there must be a careful specification of the conditions under which the solution is sought and a minimum use of conventional language. The remedy for (2) is a proper explanation and exemplification of principles. This, it is Prof. Plummer's object to supply.

The book is divided into five parts, the first dealing with the geometry of motion. In the second, Newton's laws are introduced and applied to the dynamics of translation. This part would have been improved by a somewhat fuller treatment, with more examples, of impulsive motion, for it is here that mechanical principles appear in their most applicable form without mathematical elaboration. In Part III. statical considerations are explained. Part IV. returns to dynamics, the two-dimensional motion of a rigid body. Part V. gives elementary principles of the elastic behaviour of bodies under stress. This is a welcome addition to the ordinary treatment of elementary mechanics, as it gives a glimpse of the deviations of actual solid bodies from rigidity.

Elementary notions of the infinitesimal calculus are used throughout. This is quite as it should be ; in fact the beginner profits doubly by a concurrent use of the two subjects, while to exclude the calculus is deliberately to obscure and restrict the possibilities of elementary mechanics. Good introductory text-books on mechanics are rare. Where a teacher is available the book is not the most important matter. For a student reading by himself a good book is absolutely essential. This one can be recommended.

L. M. Milne-Thomson.

Our Bookshelf.

The Sun. By Dr. Charles G. Abbot. Revised edition. Pp. xxvii + 433 + 28 plates. (New York and London : D. Appleton and Co., 1929.) 12*s.* 6*d.* net.

The first edition of this book was published in 1911. Since then, modern atomic theory has been applied as a powerful means of research into the constitution of the sun from its outermost boundary to its core, whilst observational work has been carried on with increasing scope and success. The time is therefore opportune for the publication of a revised edition embodying some account of recent achievements in solar physics.

The general reader will find that Dr. Abbot has provided a lucid account of our knowledge of the sun whether considered as the central body of the solar system (Chapter i.) ; the great luminary exhibiting a host of interesting phenomena (Chapters ii.-vi.) ; the earth's source of radiant energy (Chapters vii.-ix.) ; or, lastly, as a sample unit of the stellar universe (Chapter x.). Throughout, a good deal of attention is paid to observational methods. Chapter ix. describes the attempts made to utilise solar energy by means of solar engines and cookers.

To the astronomical reader, Dr. Abbot's book is a standard work of reference, containing a number of useful tables, and also first-hand information on the measurement of the solar-constant of radiation—

a work long associated with the name of the author and the Smithsonian Institution. It is therefore thought to be a regrettable omission that this revised edition does not include a table of collected results of measures of the solar-constant; Fig. 64, presenting the results from 1918 to 1927, is inadequate and rather exasperating with its microscopic figures. Turning the pages more or less at random, one also expected to find, in a work entirely devoted to the sun, fuller information under such headings as—faculæ, magnetic storms, latitude and time distribution of prominences, hypothetical section of a sunspot, etc. But a concluding remark must surely express gratitude to Dr. Abbot for having renewed, by this timely second edition, the usefulness of his very readable book.

Experimental Hydrostatics and Mechanics for School Certificate Students. By E. Nightingale. Pp. xi+244. (London: G. Bell and Sons, Ltd., 1929.) 4*s*. 6*d*.

MR. NIGHTINGALE has written a sound and interesting book, covering that dreary stretch in the older text-books, the elements of mechanics and hydrostatics. In general it can be commended strongly as a book which will appeal to that elusive being the normal boy. It reasons in a way he can understand; all its arguments are clear and lead somewhere soon. Both pictorial and literal illustrations are good. The large number of questions from the usual examination papers have been chosen well and are very useful.

Two features of the book are its experimental character, and the welcome prominence given to the historical development of the subject. The author believes that "a sure foundation can only be based on experiment". Here he agrees with modern educational theory, which seems to regard this as a truth beyond question. Yet experienced science and mathematics masters know there are limitations to the usefulness of experimental work, and in particular that the time spent on experiments in mechanics is out of proportion often with the benefit resulting from them. Involved here is a fundamental educational problem over which many teachers have puzzled and will puzzle. As it happens, Mr. Nightingale keeps his experiments in due bounds. Even doing them all, the course, under ordinary conditions, could be covered easily in two years, while by judicial selection of some experiments 'as read', the book can be used with advantage in the one-year course which frequently is all the student has in preparation for the School Certificate Examination. A. J. WHITE.

Plant Ecology: the Distribution of Vegetation in the British Isles, arranged on a Geological Basis. By Mary A. Johnstone. Pp. vi+185+16 plates. London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., 1928.) 5*s*.

MISS JOHNSTONE'S book on plant ecology provides at a low cost an elementary account of British vegetation. Owing to the fact that there is so small a literature on British vegetation that is not scattered in various periodicals, this book will doubtless be welcome to many students and teachers. It is, however, to be regretted that, as indicated by the sub-title, the geological nature of the substratum has been utilised as the basis of treatment. Whilst a certain measure of correlation is obvious even to the superficial observer, there are so many exceptions that undue emphasis on this relationship is to be deplored. Many mistakes in the older literature of ecology, notably in relation to calcicole and calcifuge vegetation, were the outcome of an undue faith in the connexion between soil characteristics and geological formation. The occurrence of *Querceta sessiliflorœ* on the Wenlock Limestone or of typically ash-wood vegetation on bands of cornstone in the Old Red Sandstone serve as sufficient warning against attaching too much importance to the major geological features, but when to these we add the modifying influence of topographical, biotic, and historical factors, the influence of even what may be termed the micro-geology may become entirely obscured. If, however, we discount the influence of the basis of arrangement, the student will find this introduction simply written and free from the gross teleology by which so large a proportion of elementary treatments of ecology are marred.

Traité d'embryologie comparée des invertébrés. Par Prof. C. Dawydoff. Pp. xiv+930. (Paris: Masson et Cie, 1928.) 120 francs.

THIS volume is the development of a manual of embryology which the author produced, in Russian, in 1914 based upon his course in the University of Petrograd. He set out to give the elements of embryology rather than to produce a treatise, and he has kept the needs of students steadily in mind. He gives them sound advice when he remarks that they are not to accept the view, so often stated, that the science of embryology is exhausted. In many of the groups of invertebrates the development is incompletely known or requires reinvestigation by modern methods, and much remains to be done in the study of organogeny.

An introductory chapter on the structure of the egg, on the different types of cleavage, on gastrulation and the germ-layers, is followed by the systematic study of the embryology of members of the different phyla—cœlenterates, Porifera, annelids, etc., up to tunicates, to which a hundred pages are devoted. Due attention is given to such matters as asexual reproduction and life cycles (for example, of trematodes and cestodes), and a short bibliography is added at the end of each section. The author has given a clear exposition of the essential facts of the subject.

The illustrations have been drawn in line by the author and are for the most part entirely satisfactory. Here and there a figure would have been improved by fuller lettering of its parts. At the end of the book is an index of authors referred to in the text, and a fairly detailed table of contents; an index of the genera referred to would have been helpful.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A High-Temperature Modification of Manganese.

DURING the course of X-ray studies on the copper–manganese–aluminium system (Persson) and the iron–manganese–carbon system (Öhman) respectively, we had reason to investigate the crystal structure of manganese at high temperatures. Dr. Marie Gayler (*Jour. Iron and Steel Inst.*, **115**, 393 ; 1927) found no less than four thermal arrest points in the solid state of manganese. From the study of micrographs she concluded that only one of the two lower critical points, namely, 742° ± 1° C., is accompanied by a change of crystal structure, while no such change is apparent at the other, 682° ± 1° C. The former point has also been generally recognised as the transition point β-manganese–α-manganese. Bradley (*Phil. Mag.*, **50**, 1018 ; 1925), however, has advanced the theory that the two forms of manganese exist together in a state of isodynamic isomerism within the temperature interval 650°-850° C., the equilibrium gradually shifting over to the β modification as the temperature is raised. As reference to this view has quite recently been made by Bernal (*Trans. Faraday Society*, **115**, 367 ; 1929), we may mention that we have found nothing to support such a theory. Powder photograms of pure manganese quenched from 730° C. show no trace of β-manganese, while from a specimen quenched from 760° C. faint α-manganese lines are obtained in addition to those of the β modification. This must, however, be considered as due to ineffective quenching, as in alloys of manganese with copper, which does not dissolve to any appreciable extent in α- and β-manganese, the copper phase is found to be in equilibrium with pure α- and pure β-phase at the temperatures 730° and 760° C. respectively.

If either of the two higher critical points found by Gayler, 1024 ± 3° C. and 1191 ± 3° C., is accompanied by a structural change has not been previously ascertained. The fact, however, that the alloys of manganese with copper, iron, nickel, and cobalt, which metals all have a face-centred cubic lattice, show unbroken melting curves, could not be explained if the β-manganese were stable up to the melting-point of manganese. Early in these investigations, one of us indeed found faint lines in photograms of quenched specimens of alloys of manganese with 10-25 per cent of iron, which seemed to belong to a face-centred cubic lattice.

Attempts were first made to expose a wire of manganese in a high-temperature Debye camera, but no results have so far been obtained by that method. We therefore turned to the study of quenched specimens, and this time with more success. Pure manganese on quenching gives nothing but the β modification, but by alloying the manganese with a low percentage of other metals we have succeeded in establishing the existence of another high-temperature modification. The metals employed were copper, iron, nickel, and cobalt. The manganese used for the alloys was prepared by distillation *in vacuo*.

Alloys of manganese with copper are quite malleable, and show no resemblance to α- or β-manganese even if the copper content is so low as about 5 per cent. Powder photograms of quenched specimens of alloys containing less than about 20 per cent of copper show that these alloys contain only one phase with a face-centred tetragonal lattice. The higher the copper content, the more does the structure approximate to the face-centred cubic lattice, as will be seen from the following table:

Copper (per cent).	a.	c.	c/a.
3·8	3·771 ± 0·003 A.	3·556 ± 0·005 A.	0·943
8·2	3·765 ± 0·003	3·601 ± 0·005	0·956
10·5	3·763 ± 0·003	3·617 ± 0·005	0·961
15·0	3·755 ± 0·003	3·660 ± 0·005	0·975

If a and c are plotted against the concentration, the parameter values for pure manganese can be obtained by extrapolation as follows: $a = 3{\cdot}776 \pm 0{\cdot}005$; $c = 3{\cdot}525 \pm 0{\cdot}008$; $c/a = 0{\cdot}934$ (Fig. 1). These values agree very closely with those determined by Westgren and Phragmén for the tetragonal modification of manganese obtained by electrolysis, namely, $a = 3{\cdot}774 \pm 0{\cdot}003$ A. ; $c = 3{\cdot}533 \pm 0{\cdot}003$ A. ; $c/a = 0{\cdot}937$ (*Zeit. Phys.*, **33**, 777 ; 1925 : cf. Bradley, loc. cit.). There seems to be no doubt that this modification, γ-manganese, and the high-temperature phase found by us are identical. The γ-manganese is thus in reality a high temperature modification, which explains the fact that it is rapidly transformed into α-manganese by heating to 150° C., and even at room temperature is completely changed after a few weeks.

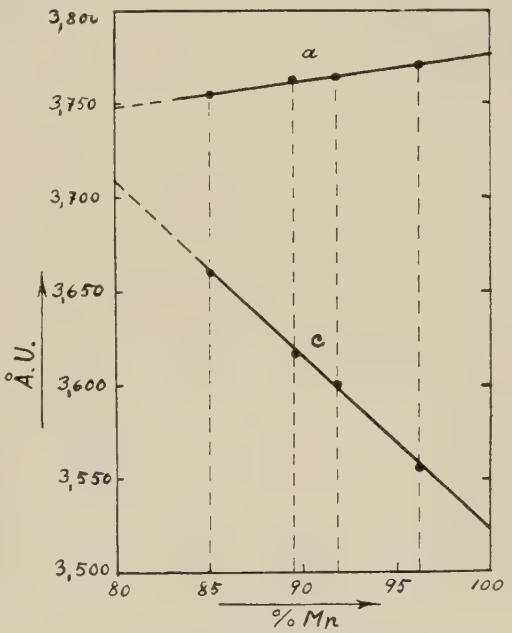

FIG. 1.—a and c, edges of the unit cell of γ-manganese with different contents of copper.

The copper alloys were found to be specially favourable for the study of the γ-manganese, since even a small addition of copper lowers the transition point γ-β considerably and copper does not dissolve to any appreciable extent in α- and β-manganese. It was thus comparatively easy to obtain the γ-phase pure, with different contents of copper, and also to obtain γ-phase and β-phase in equilibrium with each other at different temperatures. With the help of the curves in Fig. 1, the maximum manganese content in the γ-phase at different temperatures could then be determined. If this maximum content is plotted

against the temperature a curve is obtained (Fig. 2) which by extrapolation should give the transition point γ-β. It will be seen that this point undoubtedly corresponds to the highest critical point found by Gayler, namely, 1191° ± 3° C. This is further elucidated by the fact that in the manganese–iron and manganese–nickel systems the γ-phase can only be obtained by quenching from temperatures considerably higher than 1024° C. Thus an alloy with 21·8 per cent of iron when quenched from 1150° C. gives γ-phase with some β-phase, and the same is the case

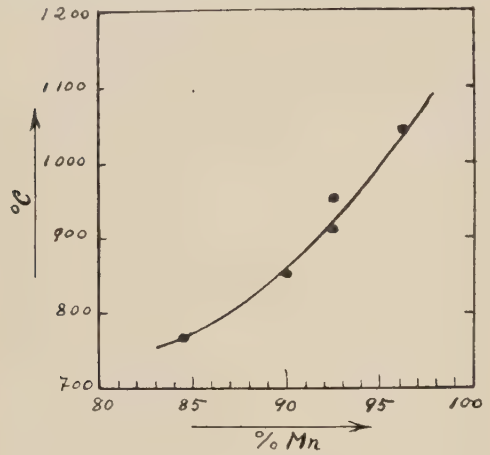

FIG. 2.—Maximum content of manganese in the γ-phase at different temperatures.

with an alloy containing 15·7 per cent of nickel when quenched from 1100° C. The crystallographic data for the γ-phase in these two alloys are as follows :

	a.	c.	c/a.
21·8 per cent iron	3·705 ± 0·003	3·619 ± 0·005	0·976
15·7 per cent nickel	3·736 ± 0·003	3·606 ± 0·005	0·965

As the β-manganese is very brittle at room temperature while the γ-manganese is malleable, it seemed probable that the transition should be accompanied by a sudden change in the mechanical properties. We found that both α- and β-manganese are much less brittle at 600° C. than at room temperature, and at 900° C. the β-manganese is in fact malleable although very hard. At 1160° C. the hardness is still considerable, while at 1200° C. the metal has become extremely soft. An alloy with 21·8 per cent of iron is hard at 1100° C. but very soft at 1150° C., while an alloy with 8 per cent of copper is quite soft at 980° C. There seems to be no doubt, therefore, that the transition point γ-β is 1191° ± 3° C. The point 1024° ± 3° C., on the other hand, does not seem to be accompanied by any change in crystal structure. It might be pointed out that the higher point in Gayler's curves is more pronounced than the lower.

No alloy of manganese with cobalt having γ-manganese structure has yet been obtained. A specimen containing 11·5 per cent of cobalt quenched from 1100° C. gave the interference lines of a face-centred cubic lattice together with β-manganese lines. The range of γ-manganese is thus considerably narrower in this system than in the others investigated.

It should be mentioned that G. Hägg of this Institute recently found a high-temperature face-centred tetragonal phase in the manganese–nitrogen system (*Zeit. Phys. Chem.*, in press). This phase was found in equilibrium with both α- and β-manganese, but the highest quenching temperature used, namely 1150° C., did not, of course, exclude a connexion at still higher temperatures between the nitride phase and a tetragonal manganese modification. There seems, therefore, to be no reason to doubt that the structure found by Hägg is identical with γ-manganese.

In no case has the γ-manganese phase been found in equilibrium with the face-centred cubic one (copper, γ-iron, etc.). This does not prove, of course, that the cubic lattice continuously changes into the tetragonal, but if a two-phase range exists, it must certainly be very narrow.

ELIS PERSSON.
EINAR ÖHMAN.

Institute of General and
Inorganic Chemistry of the University,
Institute of Metallography,
Stockholm, July 25.

Wild Birds and Butterflies.

RECENT correspondence in NATURE (May 11, p. 712; Aug. 3, p. 183; Aug. 10, p. 225) has once again brought to the fore the question of whether or not wild birds prey upon butterflies. The subject has been frequently discussed in the past both by entomologists and ornithologists and a voluminous literature exists, directly or indirectly relating to the subject, but, as Marshall (*Trans. Entom. Soc. Lond.*, pp. 329-383; 1909) has so pertinently pointed out, the supporters of adverse views are mostly those who disagree with the theories of mimicry, such as Scudder, Packard, Pryer, Piepers, etc.

It is now well known that certain species of butterflies exhibit what has been termed 'cryptic coloration', or, in other words, their colours are such that when at rest they very closely resemble their surroundings and in consequence are difficult for human beings to see. Moreover, different species of butterflies resemble one another, and in such groups there is usually one species that has a nauseous taste or foul odour, and such is said to protect the species from the attacks of wild birds. Further, as a result of natural selection, those species which resemble their surroundings and those that resemble unpalatable or inedible species, are preserved.

Here we are not concerned with the validity of any theories of mimicry or protective coloration, but rather with the evidence in support of or against the claim that butterflies constitute an appreciable part of the food of wild birds. Incidentally, we would remark that it should be borne in mind that it by no means follows that colour schemes or patterns that are difficult for the human species to see are difficult for a bird to appreciate ; and further, that an insect which smells disagreeable to man is not necessarily one that is unpalatable to birds—indeed the very reverse would seem to be the case.

The question to which we wish to confine ourselves is, Do butterflies to any appreciable extent constitute an item of the food of wild birds ? Apart from the observations and evidence that exist, we should very much doubt butterflies forming a food item of wild birds, for two reasons, namely, first, in proportion to other insects they are few in numbers, and, secondly, as an item of food their difficulty of capture, owing to their rapid and tortuous flight, make them not worth the time and trouble of catching. A bird invariably feeds upon what is easiest to obtain and present in large quantities.

That butterflies are occasionally eaten by birds, no one can deny, but not habitually ; on odd occasions they will eat them just as they do earwigs, ticks, woodlice, etc. Marshall (loc. cit.) has brought together a long list of records of cases where different species of wild birds have been observed catching, eating, or pursuing butterflies, and, interesting as these are, they are inadequate as positive evidence. When this list

was compiled in 1909, very little detailed observations on the insect remains found in the stomachs of wild birds had been made in Great Britain, and little attention had been given to work done elsewhere.

Judd, who examined many thousands of stomachs, writes, "I do not know of a kind [of bird] that feeds upon butterflies during any month of the year to the extent of one-tenth of one per cent of its food". Beal, who in his lifetime examined 37,825 stomach contents, very rarely refers to butterflies amongst the various items. In his investigation of the food of seven species of American swallows (U.S. Dept. Agric., *Farmers' Bull.*, No. 630, pp. 1-27; 1915) he examined 2030 stomachs and found that 70 per cent of their food consisted of Hymenoptera, Hemiptera, and Diptera. A specimen of *Vanessa atlanta* was found in one stomach. This same investigator in his work on the food of seventeen species of American flycatchers (U.S. Dept. Agric., *Biol. Surv., Bull.* No. 44, pp. 1-67; 1912), of which he examined 3398 stomachs, makes no mention of butterflies or their larvæ. Moths and their larvæ constituted 9·93 per cent of the food of all species.

Cleland (Dept. Agric. N.S.W., *Sci. Bull.*, No. 15, pp. 1-112; 1918) in his work on the food of Australian birds examined 1133 specimens referable to 224 species, and butterfly remains or their larvæ occurred in one case only, namely, a tricoloured chat (*Ephthianura tricolor*) which contained two larvæ. Mason ("The Food of Birds in India", 1912), after examining the stomach contents of 1329 specimens of Indian birds referable to 107 species, states, "Butterflies do not form any appreciable proportion of the food of any one species of bird, though a good many birds take these insects at times".

My own investigations, embracing more than one hundred and fifty species of wild birds and upwards of twelve thousand post-mortems, lend no support to the contention that butterflies are part of the normal food of birds. Interesting as are the observations and experiments of Swynnerton (*Ibis*, 6, pp. 635-640; 1912; *Trans. Second Int. Cong. Entom.*, 1912, pp. 351-354; 1913; *Jour. Linn. Soc.* (Zool.), **33**, pp. 203-385; 1919), they mostly refer to birds in captivity. In the very extensive investigations of McAtee, Fisher, Forbes, Forbush, Barrows, Kalmbach, and others, I find only rare and odd references, such as "and one butterfly".

The work quoted above embraces considerably more than 100,000 post-mortem examinations of the stomach contents of wild birds in the United States, India, Australia, and Great Britain, and the number of butterflies or their remains found was negligible, indeed so infinitesimal as to be of no account economically, whereas other insects occurred in thousands.

From what has been said I think we may conclude that a careful and very extensive series of examinations of the stomach contents of upwards of one hundred thousand birds lends no support to the view that wild birds do prey upon butterflies to an appreciable extent, nor are they "liable to habitual attacks upon the part of birds".

WALTER E. COLLINGE.

The Yorkshire Museum, York.

Meteorology in India.

IN NATURE dated May 4, p. 698, there appeared a review notice of the first three numbers of the *Scientific Notes* published by the Indian Meteorological Department. In criticising the first Note by Mr. Mohammad Ishaque on "A Comparison of Upper and Gradient Winds at Agra and Bangalore", the reviewer took exception to Mr. Ishaque's statement that the gradient wind equation does not hold at the equator, and described the statement as "an unfortunate mistake". Though Mr. Ishaque might with advantage have expressed himself a little more fully, it is profitable to recognise that there may be much truth behind his statement. For, it is not at all certain, as the reviewer would seem to imply, that motion in the free air over the equator under steady conditions is normally along isobars under the sole, effective control of the cyclostrophic component. On this very question Sir Napier Shaw ("Manual of Meteorology", vol. 2, p. 266) has expressed the opinion that "we can no longer assume that the motion is along isobars for the equatorial region; it is controlled by some other consideration, and we do not know how far the new form of control may extend North and South of the equatorial belt".

Mr. Ishaque's work indicated that upper winds at the levels of 0·5 km. or 1·0 km. are less closely calculable from sea-level isobars in India than in England, and the reviewer suggests that the poorer agreement in India is "a measure simply of the point to which accuracy of measurement of barometric pressure has been carried in each" country. I have good grounds for believing that want of accuracy in the actual measurement of pressure at individual stations in India is not the cause of the poorer agreement. Probably, however, the reviewer had in mind the accuracy with which the sea-level pressure field could be estimated from these measurements. Admittedly, the want of a very close network of stations near Agra and Bangalore, as well as the variable degree of validity of the internationally accepted conventions used in reducing pressure-values to sea-level (Mysore stations are more than 2000 ft. above sea), may at times lead to considerable errors in the drawing of sea-level isobars in India. There are also, however, other contributing factors, such as the fact that the conditions are far from steady near the surface owing to the alternation of inversions at night with adiabatic lapse-rates by day, and the disturbing boundary influences exerted at surfaces of inversions, the Himalayas and the Western Ghats.

C. W. B. NORMAND.

Meteorological Office,
Poona, India, July 12.

I quite agree with Dr. Normand that it is going too far to assert definitely that the possible interpretation of the small correlation between gradient wind and observed wind at 0·5 km. and 1·0 km. height at Agra, quoted above, is the true one, but I think that errors in the determination of the gradient wind are at the present time too large to justify one in accepting the results of comparisons made in different countries as indicative of the influence of latitude, without a critical examination of the effect of such errors.

On reading the chapter of Sir Napier Shaw's "Manual of Meteorology" which contains the quotation cited by Dr. Normand, and in particular the second paragraph on page 249, I concluded that the statement that "we can no longer assume that motion is along isobars for the equatorial region" is meant to apply to *mean* isobars and not to the isobars existing at a particular moment. There seems to be no obvious reason why the virtual disappearance of the term in the gradient wind which depends upon latitude should affect the closeness with which the actual free air wind on a particular occasion approaches the value appropriate to air moving under balanced forces, and a high correlation between the two seems not unlikely over those great stretches of tropical ocean where horizontal gradients of temperature are normally small.

THE WRITER OF THE ARTICLE.

Quantum Theory and Special Relativity.

IN NATURE of Mar. 2 a communication by Prof. Wiener and myself was published directing attention to the urgent need of a more thorough harmonisation of quantum theory and relativity than is found in Dirac's theory of the electron. It was further pointed out that the latter can be formally carried over into Einstein's unified theory of electricity and gravitation by making use of distant parallelism and interpreting the operators p_0, p_1, p_2, p_3, of Dirac's theory as a differentiation along the Cartesian axes of the local quadruples, which themselves need not be integrable. Since then this suggestion has been discussed more fully and independently by E. Wigner (*Zeit. für Phys.*, **53**, 592; 1929), and by I. Tamm (*Kon. Ak. van Wet. te Amsterdam*, **32**, 288; 1929). Now the Dirac theory is an attempt to reconcile the demands of the transformation theory of quantum mechanics, which alone is consistent with the observed dualism of particle and wave as Heisenberg and Dirac have shown, with the requirements of special relativity. Hence it would appear that a unified theory of matter, electricity, and gravitation is possible along these general lines.

Closer examination, however, reveals what appears to be a very serious difficulty. Let A_k be the electromagnetic potentials of the field in which the electron moves. The Dirac equation is then $(\Sigma(a_k p_k + eA_k/c) + mc)\psi = 0$ $(k = 0, 1, 2, 3)$. The probability of the electron being within a unit cube is $\Sigma\bar{\psi}_k\psi_k$ and the probability of its crossing unit area perpendicular to the axes $\Sigma\bar{\psi}_k(a_i\psi)_k$ $(i = 1, 2, 3)$. These quantities satisfy equations $\Sigma\bar{\psi}_k\psi = \Box\phi_0$, $\Sigma\bar{\psi}_k(a_1\psi)_k = \Box\phi_1$, etc., and form a solenoidal four-vector, which can be interpreted as the charge-current density vector. But the potential ϕ which describes the 'external' electromagnetic field of the electron is *not* the same as the potential A which describes the field in which the electron is moving.

This difficulty, which Schrödinger strongly emphasised in 1927 (*Ann.*, p. 270), now appears under another guise. While it is possible in principle to define the 'internal' potential A locally in a way consistent with the interpretation of the p-operators mentioned above, the 'external' potential ϕ cannot be so defined because the probability of finding the electron at any point in space is always finite, no matter where the source of the 'internal' potential (for example, proton) may be.

Prof. Weyl has given a hint as to a method of separating the protonic from the electronic field (*Proc. Nat. Acad. of Sci.*, April 1929), but it does not seem to me that his treatment is more than suggestive. In particular, it seems reasonable to suppose that if the two-body problem requires two separate electromagnetic fields, one can scarcely dispense with n fields in the case of n bodies, be they protons or electrons. Thus if the unified field that all relativistic theories up to this time have striven for has real physical significance, it must be a statistical average of some sort. Hence it appears that the time is coming when a decision must be reached on the following question: either one admits the possibility of a unified field theory of matter, electricity, and gravitation, and abandons statistical quantum mechanics, which does not seem possible in view of the accumulated evidence; or one constructs a statistical theory of gravitation and electricity and gives up the attempt to devise a unified field theory in the current sense. I feel strongly in favour of the latter alternative.

It might properly be mentioned here that an electrostatic spherically symmetrical field is incompatible with Einstein's definition of the electromagnetic potential unless past and future are not symmetrical, as Prof. Wiener and I have shown (*Proc. Nat. Acad. of Sci.*, **15**, 353; April 1929). While the method used in this paper is defective, a correct argument, which leads to precisely the same general conclusions and only introduces unessential modifications in the final formulæ, will appear shortly in the same publication.

M. S. VALLARTA.
Massachusetts Institute of Technology,
Cambridge, Mass., U.S.A.,
May 25.

Aquaria for Rearing Minute Organisms Requiring Running Water.

THE aquaria described here were designed in connexion with experimental work on oyster larvæ, and may be useful to workers on these or similar organisms. Each aquarium is a square trough, say 20 in. × 12 in. × 12 in., which will conveniently hold about 22 gallons of water. It has near the base on two opposite sides circular outlets $\frac{3}{8}$ in. in diameter, through which is cemented a stopcock of $\frac{1}{4}$ in. internal diameter. On the inside these outlets are each covered over with a glass box about 4 in. high and $2\frac{1}{2}$ in. broad, open on the side facing the opposite outlet, and containing three vertical grooves, through which glass-framed curtains of bolting silk of different mesh can be passed. These curtains can be used either jointly or singly, according to the degree of filtration and outflow desired, and the grooves or the frames should be lined to prevent leakage.

For organisms which are too minute to be filtered by bolting silk, slabs of the filtering substance employed in bacteriological filters may be used, but they would reduce the rate of outflow very considerably, and the substance known as 'Filtros', which is made in grades of known porosity, would seem to be superior. H. F. Prytherch, whose work on the artificial propagation of oysters is well known, has used it with great success in his experiments. It can be obtained in London from Messrs. Lassen, Hjort, and Menzies, Ltd., Imperial House, Kingsway, W.C.2.

The aquaria are best used by placing them side by side on a long table, the stopcocks being joined on to each other with rubber tubing and intervening T-tubes with a stopcock on the upright of the T. To carry away the waste a $\frac{1}{2}$-in. pipe may be fixed under the table with T-pieces at desired intervals, which are reduced to $\frac{1}{4}$ in. by means of a reducer and nipple, to allow the convenient attachment of rubber tubing. These T's can be connected up with the aquaria in various ways, one being to direct the outflow from two aquaria through a single T on the waste pipe by means of a Y-tube and rubber tubing. The aquaria can be easily fed from a small tap by means of rubber tubing and glass T-pieces with stopcocks on the upright of the T. This method of using the aquaria permits very considerable elasticity in working, an elasticity which increases with the number of aquaria employed.

The circulation in any application of this system where an outflow is permitted will be found sufficient for most requirements, but if further aeration is desired, mechanical agitation can be readily obtained. For this I fix upright guides between the aquaria, through which a shaft, with vertical wooden blades passing into each aquarium, is passed. This shaft is propelled by means of a small motor or water-wheel. This circulatory apparatus, except for the blades, can be quickly constructed with one of the larger Meccano sets.

CEDRIC DOVER.
Calcutta.

Feeding Habits of the Angler-fish, *Lophius piscatorius*.

IN a recent publication ("The Seas", by F. S. Russell and C. M. Yonge) a statement is made with regard to the feeding habits of the angler-fish which does not accord with my own repeated observations, and it has been suggested that I should describe the feeding habits of this interesting fish as seen by myself on many occasions in the tanks of the Marine Biological Station at Port Erin.

In the publication referred to, the angler-fish is stated to lie perfectly still with its huge mouth wide open and to appear to use the tentacle borne on the top of its head as a lure. There is no doubt, as is shown below, that the tentacle is so used, but, though the fish was always kept in a dimly lighted tank, I have never seen the tentacle luminescent. However, I have never observed the fish during the night. It was our practice on many occasions to put into the tank containing the angler a few living young specimens of the coal-fish, *Gadus virens*. These would soon be noticed by the angler, which, while remaining stationary with closed mouth, raised the lure from its horizontal position along the back and jerked it to and fro. Suddenly, as the unsuspecting coal-fish hovered over the head of the angler and sampled the living and actively moving bait—I cannot say that I ever saw it touch the bait with its snout—the angler's mouth would open and as suddenly close upon its prey; the head of the coal-fish always disappearing first, while the tail projected from the tightly closed mouth. A few seconds later the tail would be drawn by a sort of suction into the still closed mouth and the angler would be ready for another meal.

I never saw the angler attempt to pursue its prey. It was its invariable habit to lie perfectly still on the bottom of the tank, the lure being actively jerked to and fro when the coal-fish were introduced. When no prey was in view, the lure always lay horizontally along the top of the angler's head.

H. C. CHADWICK.

Marine Biological Station,
Port Erin, July 17.

Crystal Structure of Solid Nitrogen.

IN a previous communication, dated June 28 (NATURE, Aug. 17), I gave results regarding the crystal structure of the form of solid nitrogen, which is stable below 35·5° K. It was stated that the X-ray powder diagrams can be interpreted with respect to the positions of the lines by means of a cubic unit cell the length of the side of which is 5·65 A., and containing 8 atoms.

Since then, the work has been continued, and after a long and laborious discussion of the various possibilities, we have now succeeded in finding the atomic arrangement which satisfies the intensity distribution of the X-ray spectrum. Our results, which will be more fully described in a subsequent paper, may be shortly stated as follows:

Solid nitrogen of the form considered has a pronounced molecular structure belonging to the space group T^4, and similar to that of the sodium chlorate type. The molecules—each consisting of two atoms—are placed on the four non-intersecting trigonal axes typical for this space group. The structure has two parameters, by a proper choice of which we obtained a remarkably good agreement between calculated and observed intensities. The parameter values thus found led to a distance of 1·06 A. between the two atoms of a molecule. If we could consider the molecules as spheres, the structure might approximately be regarded as a cubical close packing of molecules, with a minimum distance of about 4·0 A. between their centres.

Sodium chlorate, in the cubical form, turns the plane of polarisation and shows anomalous behaviour in producing double refraction. The similarity with regard to crystal structure would indicate that solid nitrogen should possess similar optical properties. In fact, D. Vorländer and W. H. Keesom (*Comm. Phys. Lab. Leyden*, No. 182 *c*; 1926) have found that solid nitrogen shows double refraction, and we intend to undertake experiments at this Institute with the object of discovering whether solid nitrogen gives any rotation of the plane of polarisation. L. VEGARD.

Physical Institute, University,
Oslo, Aug. 1.

Optical Excitation of Phosphorus Vapour.

ON illuminating the vapour of phosphorus by the light of various sparks, we obtained a fluorescent emission in the region 3500-1900 A. The vapour was contained in an evacuated and sealed quartz tube into which a quantity of carefully dried white phosphorus distilled *in vacuo* was previously introduced. The temperature and pressure of the vapour could be varied independently by an oven and a water bath. In order to obtain the fluorescence, heating of the vapour up to 600°-700° C. was found to be necessary, the vapour pressure being kept low (*c.* 0·1 mm.). The phosphorus molecules, which consist normally of four atoms (P_4), dissociate under these conditions into diatomic molecules (P_2) to an appreciable amount.

The spectrum of the fluorescence consists of resonance series excited by the spark lines 2195 and 2144 of cadmium, 2100 and 2062 of zinc, 1990 and 1935 of aluminium. The analysis of these series enabled us to estimate the first vibration quantum of the normal P_2-molecule as 775 cm.$^{-1}$ and its dissociation energy as 6 volts. Of various emission spectra of phosphorus in an electric discharge studied by Geuter (*Zeitsch. wiss. Phot.*, **7**, 1; 1907) only one, designated by him as *C*, is ascribed to the P_2-molecule. It shows the same sequence of vibration quanta as our resonance series in the near ultra-violet. From the combination of these data an energy diagram of the P_2-molecule (similar to the N_2-molecule) was constructed in which the convergence of 'upper' vibration quanta ($\omega' = 450$ cm.$^{-1}$) seems to correspond to a dissociation of P_2 into $P + P'$, where P' designates the atom of phosphorus in its first excited metastable state ^2D, 1·4 volt above the normal state ^4S (cf. McLennan and McLay, *Trans. Roy. Soc. Canada*, **31**, 63; 1927). The results of a complete analysis of the emission and absorption spectra will be published elsewhere.

A. JAKOVLEV.
A. TERENIN.

Physical Institute,
University of Leningrad.

Iceberg Detection.

(BY CABLE.)

ONE of the interesting results of the Van Horne expedition just returned from iceberg study on the Atlantic was obtained with our submarine microphone detector. Very loud deep noises were heard three miles from an iceberg and became faint at six miles.

These noises are apparently due to the cracking under water of the iceberg, and they could readily be heard above the usual ship's noises. The succession of cracks was irregular, running from 11 to 68 a minute. The effect is so characteristic that we propose to extend the investigation in the hope of finding a method of iceberg detection.

HOWARD T. BARNES.

McGill University, Montreal.

Methods of Timing High-Speed Races.

By CECIL C. MASON.

IN the usual method of timing races with stop watches the errors can be divided into two main groups :

(1) Errors due to incorrect clock or watch rate, and also mechanical error due to incorrect starting and stopping or calibration.

(2) Errors due to inaccurate observation of the start or finish of the race ; including errors due to variations in the reaction times of the individual working the stop watch, that is, variation in the time between the mental observation and the mechanical response.

These errors are of different importance in short and long races. For example, in a very short race an actual error in the rate of the stop watch would cause errors quite negligible compared with many other probable errors, but, on the other hand, mechanical errors in starting and stopping the watch mechanism and in reading the dial due to inaccurate calibration are only important in short races. For short races, therefore, it is best to use a fiftieth-second stop watch, but for long races a greater over-all accuracy will often be obtained by using a fifth-second stop watch.

In an ordinary stop watch the motion is stopped by a light spring being pressed against the balance wheel ; and in motion the balance wheel in vibrating releases the escapement, and moves the hand forward one division every $\frac{1}{5}$th second.[1] When stopped, therefore, it may be any interval of time from 0 to 0·2 sec. since the last movement of the hand : and when again released it may similarly be any interval from 0 to 0·2 sec. before the first movement occurs. On the assumption that the balance wheel on starting immediately gets into a steady state, we therefore see the true meaning of a stop watch reading $5\frac{1}{5}$ is that the interval is between 5·0 sec. and 5·4 sec., and any reading between these limits is almost equally probable. If, therefore, two observers use two different watches, and the second reads 5 sec. for this same event, neglecting other errors it is scientifically correct to assume the true interval is between 5·0 sec. and 5·2 sec. ; and so on, if several observers use several watches, the mean reading has quite possibly, if the readings mutually agree well, a real scientific accuracy exceeding $\frac{1}{5}$ second.

Calibration errors in stop watches are probably negligible apart from the centring error. However, in small cheap watches often less than $1\frac{1}{2}$ in. in diameter, where the dial is divided in 300 divisions of $\frac{1}{5}$ sec. each, the centre of the hand need only be 0·01 in. out of centre to give, in parts of the dial, an error of $\frac{1}{5}$ sec.

In the second class of error, the chief cause of observational error is due to the usual practice of observing different things at the start and finish of a race. Perhaps the observer starts his watch on observing the flash of the pistol. This is a sudden event which cannot be anticipated, but must be closely watched for and awaited. Hence the watch is started after a delay due to the reaction time of the observer. However, in watching a runner approach a tape, the event can be exactly anticipated, and the observer can stop his watch almost exactly as the runner hits the tape. In this case there is no delay due to the reaction time of the observer. This can be proved by treating the second hand of a $\frac{1}{50}$th sec. stop watch as the runner and stopping the watch as the hand reaches a chosen division. Therefore the correct way to time a race is to have similar signals for starting and finishing both timed by the same observer. For example, if the race is started by a pistol, then the finish should be signalled by a second pistol, fired by a practised observer watching the runner hit the tape. The timekeeper then times the interval between the pistol flashes, or stands equidistant from the two pistols and times the interval between the reports. Certainly this introduces a second observer, and so increases the chances of human error, but the method is more accurate than the usual practice, and we are left with the small observational error in firing the second pistol, and with the error due to variation in the timekeeper's reaction times in the two events. Alternatively, the timekeeper should know his mean reaction time, and when timing himself directly on starting pistol and finishing tape, he should add his mean reaction time to the watch readings. This reaction time varies from individual to individual, but is roughly constant for most individuals, and resulting errors can never be abolished so long as the timing mechanism is worked by human agency, except by multiplying the number of observers.

Several Swiss firms now make good stop watches with escapements beating fifty times a second. When testing mechanical fuses, I had an opportunity of making some hundreds of observations of my own timing errors in easy conditions for observation with $\frac{1}{50}$ sec. stop watch against a reliable mechanical record. I found my mean reaction time to be about 0·15 sec. or 0·16 sec. with a probable variation of 0·02 sec., and it could vary between 0·11 sec. and 0·20 sec. without my being in the least aware that I had been exceptionally quick or slow. When I was slower than 0·20 sec., I was usually aware that I had made a bad observation. These experiments did not distinguish between the different causes of error mentioned. The mean starting error of the watch in this case would be 0·01 sec., and the observational error as distinct from my reaction time was, I think, small and constant. I think, however, 0·02 sec. is not a large mean error to assume for the variation of reaction time in the average observer. Using a $\frac{1}{50}$ sec. watch, therefore, a single observer in the best conditions can hope for a mean probable error of 0·04 sec., or even 0·03 sec. with care and practice ;

[1] The following argument and conclusion equally apply to a complete watch, fitted with centre seconds hand with stop mechanism, since in this case the hand is worked by toothed wheels thrown in and out of gear, which can only engage in steps of a whole tooth.

but the error may easily be 0·06 sec., and in bad conditions even much greater, especially when the observation error is likely to be large.

With several observers and several $\frac{1}{50}$ sec. watches, the probable error can be reduced to 0·02 sec. or less in the best conditions. The watch errors themselves, however, soon become large if a time interval exceeding a few minutes has to be recorded, as a fast escapement is necessarily very light, and therefore a bad regulator.

Using a $\frac{1}{5}$ sec. watch, a single observer cannot time an event with a mean probable error of less than 0·1 sec., even when the observation is properly made or corrected as above indicated, and I think, taking all errors into consideration, we shall not be far wrong in saying that the probable error is nearer 0·2 sec. than 0·1 sec. and that the error may be so large as 0·3 sec. without the observer being conscious of making a bad observation, and will certainly be from 0·1 sec. to 0·2 sec. too short if improperly observed and uncorrected.

Owing to the errors necessarily associated with the use of stop watches actuated by human agency, a demand arose many years ago for more accurate methods of timing, and recording chronographs have been used for many scientific purposes. The Cambridge Instrument Co., Ltd., for at least thirty years, has made a chronograph with three pens recording on a paper strip, and this instrument has been much used in laboratories for many purposes. The pens are moved by electromagnets, so that to obtain a record an electric current must be made or broken. One pen is actuated by a 50-period tuning-fork or by a seconds clock, and the other two pens are available for recording the instants at which electric currents are made or broken. With this instrument, without any particular care, accurate records of the making and breaking of the circuits may be taken to one-hundredth of a second, and as a current lasting for only one-thousandth of a second is sufficient to give a readable record on one pen when suitably adjusted, it is clear that by running the paper fast enough, the instrument itself is capable of giving readings to 0·001 sec.

For timing motor-car races a somewhat similar instrument made by Messrs. Thomas Mercer of St. Albans is now generally used. Messrs. Mercer are chronometer makers, and they have made a very convenient portable instrument comprising a three-pen chronograph and a chronometer giving seconds contacts, and the recording strip of paper is driven by clockwork. The recording pens are actuated by means of contacts placed on the track. These contacts are in the form of strips which are normally kept apart, but are pressed into contact by the wheels of any car passing over them. The chronograph is fitted with electromagnets of the Holden type. It is clear that the duration of the contacts caused by a car at high speed is exceedingly brief, so that the electromagnets operating the pens must give a very rapid response. The armatures are actually held against the poles by permanent magnets against the action of strong springs, and the springs can be adjusted so that they are only just insufficient to pull the armatures off the poles. The current from the track contacts then passes through electromagnets which temporarily slightly demagnetise these permanent magnets, thus releasing the armatures, so that the pens move a full distance, even for a very brief current.

The defect of the arrangement, of course, is that it necessitates the re-setting of the pens before a second record can be taken. Hence an accidental contact might throw a pen out of action just as it was required. However, with ordinary electromagnet pen control, a succession of contact strips could be used at short intervals at the start and finish of the track. This would avoid the risk of one contact failing, if an uneven track caused a wheel to jump the contact, and it would eliminate doubts as to the correct interpretation of contacts, and by giving multiple records it would increase the mean accuracy. There is a distinct risk with the Holden magnets that the start is operated by a back wheel, and the finish by a front wheel, giving an error at 200 m.p.h. of 0·03 sec. or more. With the Holden type of magnet, it is also necessary for a short race that the start and finish of the race be recorded on two separate pens. This always gives a slight risk of error if precautions are not taken to see that the pens are exactly in line. Also, as the chronograph only gives contacts every half-second, it is important that the speed of the paper be quite uniform. Care must be taken, therefore, to see that the governor acts smoothly and does not cause hunting between a lesser and a greater limit of speed.

However, with this type of instrument it should be quite easy to obtain records with an error not exceeding 0·01 sec., which should be good enough for all practical purposes. Actually the readings can be easily taken to 0·0025 sec., and with care this accuracy might be obtained, but I doubt if the chronograph contacts are really reliable to this order of accuracy. With a car moving at 200 m.p.h., this only means an error of 9 in. in the position of the car: and the tracks must be straight and accurately measured if this accuracy in time is to be of value. These Mercer chronographs were used by Sir Henry Seagrave at Daytona Beach, Florida, and also by Capt. Malcolm Campbell at Verneuk Pans.

We now come to the problem of timing speed records of an aeroplane. In this case it is clearly impossible to have the aeroplane making its own contacts at the starting and finishing points, but again, as the aeroplane must make a flying start, accuracy can be obtained by increasing the number of observations, or in effect increasing the number of starting posts and correspondingly increasing the number of finishing posts; also, the number of observers can be increased with ease, as the aeroplane is bound to be high up and, therefore, visible over a large area. Therefore with, say, two chronographs, I do not think there should be any difficulty in obtaining results accurate to one-hundredth of a second, if the starting and finishing posts can be near enough together, so that both starting

and finishing can be recorded on the same chronograph. In this case the chronograph must not be fitted with Holden electromagnets, but must be of the usual type as fitted in the Cambridge instrument. The observer will then press a contact on observing the aeroplane cross each of a series of planes which can be defined by the observer looking through a small aperture and observing when the aeroplane crosses a series of wires.

The observer should be a good distance from the course, so that the series of planes forming the starting posts may be a reasonable distance apart to enable the observer to get a series of records without being hurried, and also it is desirable that these planes, which must all meet in the vertical line through the observer, should not be at too great an angle with each other, thus introducing complications in the calculations, and even errors, if the aeroplane is far off its course. Errors, however, would be eliminated by having an equal number of observers on each side of the course and taking the means, or, if the exact track of the aeroplane is recorded, proper corrections can be calculated.

We will now consider alternatives to this method suggested by the practice of other sciences. The most obvious parallel occurs in astronomy. It is one of the commonest observations to take transit times, that is to say, the time at which a certain star crosses the meridian. It is practically the same problem as that of obtaining the time at which an aeroplane crosses a certain plane in space. If the observer can get far enough away, it is easy to follow the aeroplane in a telescope, and with a suitable mounting the telescope can be rotated in the plane containing the observer and the course of the aeroplane so as to keep cross lines in the telescope sighted on the aeroplane. If contacts are placed upon the training mechanism, the instants at which the aeroplane crosses a series of planes can be recorded without any lag or error due to the reaction time of the observer, and the error due to inaccurate following of the aeroplane can be greatly reduced by having a whole series of contacts. The observer does not know when each contact is occurring; in other words, there is nothing to flurry the observer; he can concentrate his whole attention on smoothly following the aeroplane with the lines in the telescope.

Since writing the above, I have been able to discuss the problem with Mr. R. S. Capon, who is now superintendent of scientific research at the Royal Aircraft Establishment, South Farnborough, and he tells me that he was led by exactly similar reasoning to the method which has been in use for some time on the speed course at Martlesham. With a large object like an aeroplane the telescope is unnecessary and open sights were used. To commence with, a camera free to turn about a vertical axis was used at each station as a check. Open sights on the cameras were directed by each observer on the aeroplane, and an arrangement was fitted whereby the shutter of the camera is automatically tripped when the axis of the lens is directed to the starting (or finishing) point. Simultaneously with the tripping of the shutter a recording pen marks the moving tape of the chronograph. Seconds from a reliable chronometer are marked on the tape by a third pen. The camera supplies information as to whether the observer has kept his sights correctly on the aeroplane. In this way it has been found that the method is normally so accurate that it is now usual to dispense with the taking of photographs and to rely on correct sighting by the observers (see *Jour. Roy. Aero. Soc.*, No. 194, vol. 31, February 1927).

A different method has been used for trial flights on the high-speed course at Calshot, mainly because certain apparatus happened to be available which could be applied to this problem without additional expenditure. The method has been worked out by Mr. Garner of the Royal Aircraft Establishment. In this case electrically driven Veeder counters are being used, operated from a tuning-fork giving ten complete vibrations per second. Two counters are used, one driven from a contact on one side of the fork and the second from a contact on the opposite side of the same limb of the fork. Hence the counters move forward alternately every twentieth of a second, each counter moving every tenth second. The problem in this case is simplified, as the Schneider Cup races start and finish at the same point. At the observation post a kinematograph camera is fixed in the starting (and finishing) plane, and the figures showing in the Veeder counters can be photographed simultaneously with any aeroplane crossing the observation plane. In this way, by running the kinematograph film at a fast speed, several pictures of the aeroplane are obtained, together with the readings of the two Veeder counters. From the photographs, the position of the aeroplane at start and finish and the time interval can be worked out with ample practical accuracy. The running of the tuning-fork can be checked immediately before and immediately after any flight.

This method is really only suitable when a race finishes at the starting-point, as there would be difficulties in synchronising Veeder counters at two separate observation posts. Generally, the method is not so accurate as Mr. Capon's, but it is no doubt attractive to persons who like to see instruments reading on actual dials in preference to having to measure up records.[2]

As a variant on Mr. Capon's method, which avoids turning the camera, and eliminates errors due to lag in working the shutters, I would suggest fixing the camera so that its position is very accurately known, and taking a single photograph when the aeroplane is known to be in the field. Behind the plate I should put a photoelectric cell which would record instantaneously on a chrono-

[2] Since this was written, it seems that a slight modification has been introduced for use on the straight three-kilometre speed course at Calshot. Instead of Veeder counters outside the camera, rotating discs controlled from the tuning fork are fitted in cameras at each end of the course, both cameras being electrically connected to the same fork. Thus shadow photographs of numbers perforated in the discs are obtained in the successive kinema photographs. The method for a short course is undoubtedly very accurate, as the position of the aircraft can be worked out from the photographs with any accuracy justified by the speed of the photographs.

graph through suitable amplifiers, or photographically with a string galvanometer, the exact moment of the exposure of the plate, and from the plate itself one could calculate with sufficient accuracy the exact distance of the aeroplane from the true starting or finishing post. This, however, considerably increases the cost of the required apparatus.

Mr. Capon has also patented (see Patent No. 279,959) an alternative method which is capable of very great accuracy. In this method a camera is placed at each observation post with the lens pointed normally to the course. A film is moved at constant speed in each camera across a narrow slot. In this way a continuous photograph is obtained of a narrow strip defining the starting (or finishing) plane. Any object crossing the plane is therefore recorded, more or less distorted, however, depending on its speed and that of the film. The films can be synchronised and marked with regular time intervals by means of sparks in spark-gaps near the slots, or by other suitable means.

Experimental Method in Psychology.[1]

By F. C. BARTLETT.

THE position which psychology occupies to-day in relation to the other biological sciences, both theoretical and applied, is due directly to its adoption of experimental method. Yet if the psychologist is asked to point out any single unshakable discovery of first-rate psychological importance, based directly and wholly upon experiment, his attempts to answer the question are always regarded as unsatisfactory.

As is known, the earliest experimentalists in psychology were physicists and physiologists, most of them with a strong bent towards philosophy in their outlook. They set up a standard which in various ways has cramped and confined experimental psychology ever since. When a physicist approaches a problem in which he has to state how a stimulus affects any kind of response, he is bound to lay the burden of explanation upon the stimulus. When the physiologist approaches the same type of problem, his emphasis is equally bound to be mainly upon the response side of the relationship. This he perfectly legitimately isolates so far as possible, trying to state its characteristics in terms of the functions of the mechanism immediately concerned.

These are precisely the type of problem that the psychologist has most often attempted to carry over into his own field. Let us consider one point which grew out of the early experimental work on psychophysical methods. Fechner believed that all the content of experience, from the relatively simple sensation to the most complex reasoning content, was definitely measurable. Mainly as a result of his own observations, but aided also by the earlier work of Weber, he thought he could demonstrate this experimentally by showing that stimulus intensities and sensation intensities are related by a definite principle, the value of the unit sensation varying with the modality of stimulation. In order to establish the zero point for a sensation of given mode, and also the series of just noticeable differences piled up from this point by increase of the stimulus, he carried out a wonderful and patient series of experiments. He employed and somewhat improved Weber's method of 'limits'; he developed the method of 'mean error', but he relied mainly upon the method, already proposed by Vierordt, of 'right and wrong' cases. This raised the problem of the doubtful judgments.

A controversy grew up which has proceeded voluminously ever since, though at the moment it seems nearly to have worn itself out. Broadly, four plans for dealing with these 'doubtful' judgments have been proposed and followed:

(*a*) to divide them equally between 'right' and 'wrong' cases;

(*b*) to ignore them;

(*c*) definitely to instruct the observer to 'guess' when he is uncertain and then, if doubt still persists, to lump all cases together with 'guesses of greater' and 'guesses of less' as constituting an area within which stimulus variations have no corresponding sensation differences;

(*d*) to prohibit the observer from being doubtful.

All these devices ignore the very points which are psychologically the most interesting and important. First they tend to treat each judgment in the series as equally and independently significant, the function of the immediate stimulus. This is certainly wrong. Secondly, no judgment of this type is the expression of a simple stimulus-response situation, but of a stimulus-attitude-response situation. To demand guesses and to prohibit doubt both alike determine an *attitude* of observation which spreads over the whole experimental situation, affecting judgments which are assigned certainty just as much as the others.

When an observer enters into an experimental situation, he brings with him propensities, tendencies, preformed organised systematic modes of response, the preformed cumulative organised effect of a mass of past discriminations. The stimulus, the situation that is presented, hits off some of these. They appear in him as an 'attitude', and it is under the active control of this that he makes his responses. Only when we know more about how this is set up and about its precise effect upon the responses made, can we safely give to the latter the necessary weighting which makes their statistical treatment genuinely significant. I think that the psychophysical methods, studied from this point of view, will yet yield some enormously important results.

If the physicist in his approach to the stimulus-reaction type of problem tends to treat the stimulus regarded objectively as the main point of interest,

[1] From the presidential address to Section J (Psychology) of the British Association, delivered at Cape Town on July 26.

the physiological method of approach is equally bound to concentrate its attack upon the immediate functional mechanism. From the earliest days up to the present a great part, perhaps the greatest part, of experimental psychology has been concerned with special sense reactions. Yet the psychologist has never staked out clearly any mode of investigation or characteristic problems which are specially his own in this field. In this he has again been over-influenced by the great founders of his science.

Yet it is not the psychologist's view of the problem, but his handling of it, that has been faulty. Suppose we are investigating some specific sensory threshold. The response of our observer will be determined by a number of groups of factors. There are the physical characters of the stimulus: its intensity defined physically, its duration, often its medium of conduction to the sense organ concerned, relevant facts of its physical and chemical structure. There is the absolute sensitivity of the local responding physiological system, though this can never be absolutely measured short of cutting it out of its organic setting, which is just what the psychologist must not do, though the physiologist certainly may. There is the order of presentation of the stimulus in its series, which raises problems already touched upon in connexion with the psychophysical methods; and the correlated physiological questions of the state of adaptation at the moment of the sensory system.

Operating over and above and through all of these are the tendencies, attitudes, moods, intellectual and emotional habits of the observer, the states variously characterised as states of confidence, hesitation, doubt, timidity, assertiveness, certainty. An image, flashing out suddenly at a given point, may change the whole character of a response and of succeeding responses. So may the verbalisation or formulation of a judgment.

These so-called higher mental processes are precisely the psychologist's main concern. They can be experimentally set up and controlled to a large extent, while the other factors are kept relatively constant. It is our business to show how they are set up, and how they then powerfully determine reactions within the special sense field, even in the simplest cases of reaction. It is of no use simply to say that there *are* these determinants, and then to take refuge in a fruitless hypothetical physiology of the central nervous system. Perhaps the time may come when the bulk of sense psychology will be swallowed up in physiology, but that time has not come yet, and if we act as if it has we gain little but deserved suspicion from other scientific workers.

Already there are a few experimental studies of special sense problems from this point of view. They are less frequent and less thorough than they should be, and this is because the psychologist has generally been content to follow his more physically and physiologically minded predecessors, instead of envisaging the problems of sensory reaction for himself. When the psychologist studies a special sense response, it is his business to try to show how that response, carried out in its normal organic setting, is being determined directly by facts other than those of the immediate sensory mechanisms. Cues other than those of the special sensory stimulus are operating through response systems of a higher, or more complex, order than those of the directly excited sense. For these response systems at present psychological names have to be used, and we have to show how they come into play and what they do.

It should therefore be particularly interesting to turn to the experimental attack upon the higher mental processes. I propose to take as typical the study of the responses called 'remembering' and 'recognising'.

The experimental investigation of memory is dominated by the work of one man who is commonly supposed to have been a great benefactor of experimental psychology, but who, in spite of his impressive work, seems to me to be the errant leader of a very sheep-like flock. In 1885 Hermann Ebbinghaus published his new programme for experiments on memory processes. Already, since 1879, he had been studying his own modes of recall by methods which were at that time novel. The publication of his results settled the direction of flow of the main stream of experiments on memory from that day to this.

As is now well known, Ebbinghaus's great innovation was the use of nonsense syllables for memorising. He claimed four great advantages for these over any other type of material: they are simple; they are homogeneous; they can be indefinitely combined, but in all combinations the material remains essentially on the same level; they "admit of quantitative variation which is adequate and certain". It is fairly easy to show that not one of these four claims is in fact sound.

There is thus the old difficulty in a new form, the exaggerated respect for the stimulus or the situation. The psychologist is studying the complex responses of a highly developed organism and how they are determined. They have been called forth to meet the claims of a very unstable and varying objective environment. They are no doubt in many ways more stable than that environment. But if the environment is violently simplified it is mere superstition to trust that they also get simplified in a corresponding manner. They become different, but are just as likely to become yet more highly complex. Stability of determination, not simplicity of structure in objective determining factors, is what we need to make our experiments convincing. Stability of determination is compatible with complexity, and even with considerable variation of objective determinants. Somehow an experimental method has to be developed which recognises this fact.

I turn for a moment to experimental work on 'recognition' merely to bring out one further point of method. Since very early days an enormous amount of work has been done on this topic. It has issued in five or six different theories no one of which can claim finality. The diversity of this result is due to different causes, but one is perhaps

particularly important. There is a strong tendency, when any complex response like recognition is being studied, to attempt to draw a ring round it and to seek its explanation within these imposed limits. Thus the explanation of recognition is sought in something that happens at the moment of recognition. This is surely wrong. An object or event may be recognised or not largely on a basis of how it was reacted to in the prior perception. A sound, for example, may be heard: it will not be recognised unless it is so listened to that it possesses qualities, characteristics, a setting, and a significance. To the persistent study of a complex mental response as if its psychological explanation must be found inside an imaginary circle that encloses it, much of the disrepute into which experimental psychology tends to fall may be traced. It is perhaps the last and subtlest form of the outworn 'faculty' psychology.

I said at the beginning that the early experimentalists in psychology were physicists and physiologists with a strong bent towards philosophy. If in the history of the subject experimental psychologists have shown themselves too submissive to physical and physiological methods, it is even more true that they have often pursued philosophical ideals. This pursuit is in full cry still. A very brief consideration of current movements which originate in the laboratory will illustrate this point.

There is probably no contemporary movement in psychology which has more profoundly influenced psychological thought in English-speaking countries than the so-called *Gestalt Psychologie*. I have, as every experimental psychologist must have, a very great admiration for the brilliant work of Wertheimer, Köhler, and Koffka. It has shed much new light on old problems, as well as a good deal of old light on new problems. It starts specifically from experiments upon visual perception and its primary method is that of phenomenological description. When we are presented with a perceptual situation, what is it that we experience? The answer is inevitable and is one which, from this point of view, has, I think, always been given. We cannot describe our experience in this sort of situation as a mosaic of tiny bits each corresponding with its isolable part of the stimulus or situation. The blue sky which is seen is not, as Köhler says, made up of an infinite number of blue sensation units, but is seen as a continuous blue expanse. The moving dots and lines, in Wertheimer's experiments, are seen, not as stationary points in temporal relations, but as a unitary and indivisible movement.

Sometimes the experiments are more behaviouristic, but still it is the attitude of phenomenalistic description that determines their interpretation. The animal that has been trained to react positively to *a* and negatively to *b* at once reacts positively to *b* if *a* is removed and *c* is introduced bearing that relation to *b* which *b* had to *a*. This must be because the initial reaction was not to *a*, or to *b*, and not to *a* and *b* and a relation between *a* and *b*, but to a total indivisible situation only to be described as *a-b-in-relation*. Again, an animal is set a complex problem and typically achieves the solution suddenly; for what we call the 'correct' solution is a reaction to the total situation as built, or figured, or formed.

Thus a fundamental psychological question tends to be: "What is the nature and what are the characteristics of these indefeasible forms or patterns which stand over against all our reactions, compelling them to be as they are?" In our answer we can easily slip into the persistent error of over-emphasis of the objective side of the situation-response problem. I do not say they do this, but in his doctrines of physical *Gestalten*, Köhler comes very near it. Or again, looking to the response side, we may try to build up inside the responding mechanism a complex system, somehow corresponding to the integrated phenomenal situation. Then, as in Köhler's theories of ionic concentration within the central nervous system, we are almost sure to slip into sheer speculative physiology. Finally, the phenomenological attitude seems bound to issue in a comprehensive theory about the nature of the world as we know it, rather than in a scientific study of the determination of human response. It is the latter alone which is truly amenable to experimental treatment.

There is another contemporary movement, also originating in Germany, much less widely influential in other countries at the moment, but likely to attract more and more attention. This springs from the work of Prof. E. R. Jaensch. It also has a definite experimental basis. Jaensch experimentally discovered a type of imagery which seemed to lie somewhere between the after-sensation on one hand and the genuine memory image on the other. I cannot attempt to describe his extremely keen investigation of this *eidetic* imagery, as he called it. At the moment the main point is that he considered it demonstrable that a proneness to eidetic imagery is correlated with a number of other reaction tendencies. He elaborated a theory of the twofold division of all human subjects into integrate and disintegrate types. The integrate is the artistic, synthetic type, taking everything as a whole and having an inevitable accompaniment of persistent marked temperamental qualities and tendencies. The disintegrate is the scientific, analytic type, tending to split up presented situations and to deal with them piecemeal, and he also has his invariable, persistent, accompanying temperamental character.

Now this view does certainly seem to be biological in bent, and it is being explored throughout by experimental study. Moreover it strives, and, I think, successfully, to avoid that artificiality which, as we have seen, hangs over conventional laboratory methods for the investigation of the higher modes of human response. It rightly treats our problems as problems of reaction tendencies, of their determination and their grouping. But it does seem to be rather in a hurry with its sweeping generalisations.

In contemporary English psychology there is only one complete and world-explaining system of this sort, and that is the system which has been

developed by the keen and penetrating work of Prof. C. Spearman. Here again we are invited to begin with experiment, not merely upon perceptual processes, not merely upon imagery, not merely upon more complex intellectual responses still, but upon any psychological problem whatever. Wherever we begin we shall speedily find illustrated the working of the few immutable laws upon which all mental structure, and it may be the very universe itself, are built. They stand indeed at the portals of our science. Know them and everything is plain; ignore them and all is confused. They are conceived, not as tendencies serving the ends of biological adaptation, but after the fashion of physical principles of universal scope describing the inevitable structure and frame of mental life.

That Prof. Spearman has done more for the development of several fields of psychological research than any other living Englishman cannot be disputed. His contributions to the development of psychological statistics, and his work in the field of the investigation of intelligence must give him a permanent place in the history of the subject. Yet the notion of experiment mainly as a tool for laying bare and illustrating the operation of a few basic and fixed laws must seem to the biologically minded investigator very unsatisfying.

No survey, however scrappy, of contemporary movements in experimental psychology can be satisfactory without some reference to behaviourism. Of all the movements this is the one which is most thoroughly experimental, alike in its methods and in its formation of problems. It has laid firm hold on the point of view that experimental psychology is an investigation of the conditions determining high level biological reactions in animal and man. It is so round in its denunciation of philosophy that its excessive readiness to systematise its own principles of explanation is amusing. We can see this readiness in the haste with which it has exalted the principle of 'conditioned reflex' into an all-embracing explanation, though many of the problems of human response concern the emergence of new effector functions and conditioned reflex has nothing to do with this, and though conditioning at the human level is excessively speedier and often far more stable than anything that has ever been experimentally observed.

We can see it, also, in the behaviourist's dogmatic assertion that the development of consciousness within any type of biological response never makes any difference in subsequent response. Such dogmatism is only another instance of the experimental psychologist's fatal proneness to run beyond his data. It is explicable in the light of a study of the origins of behaviourism, for it was by the adoption of behaviouristic methods alone that the investigation of animal response below the human passed from the anecdotal and analogical stage and became genuinely a part of biological science. But to push the principles involved into the whole of human psychology is just as bad as to carry out some departmental investigation into perceiving, or imaging, or thinking, or some sensorial function, and then to use the results forthwith as a master-key to all the problems of human determination.

Some of the reasons why experimental psychology has often attracted unfavourable criticism and failed to hold its students should now be clear. In work on the special senses it has frequently attempted to deal with problems that the physicist or the physiologist with their specialised training could solve more satisfactorily. In dealing with the higher mental processes it has been overimpressed with the necessity of standardising objective situations and has constantly proceeded as if the simplification of a stimulus were equivalent to the isolation of a response. Persistently it has shown unnecessary readiness to build upon specialised investigations wide systems which pretend a finality and universality that they do not possess.

I believe the time has now come for pushing these criticisms vigorously and for attempting to meet them in practice. It could scarcely have come much earlier. After all, whatever the limitations of his outlook, it may fairly be claimed that the experimental psychologist has done more than anybody else to keep alive the interest in special sense problems. As for the work upon relatively more complex processes, a new and struggling science was almost bound to imitate methods already fully established in other fields and to exploit them so far as they would go.

Holding all this firmly in mind, what conclusions can we draw? First, it follows that the experimental psychologist must claim that for the present, and perhaps for always, he is as much clinician as experimenter. He has not merely to arrange conditions and record results. There seems to be a notion abroad that there is so much uncharted ground in psychology that an investigator can do anything he pleases, and so long as he observes everything possible, his results are bound to be significant. This is utterly false. His observation is definitely that of a man with a problem, and generally also with a personality, in view; and it is by consequence almost glaringly selective. He is not alone among experimenters in this respect.

From a reading of the theory of the matter one might be tempted to suppose that the best experimenter would, once the experiment is arranged, be merely a rather complicated and delicate recording and calculating device. Those who have a reputation for brilliant experimental work in any field singularly fail to impress this character upon the intelligent and sympathetic onlooker. Anybody who by experiment is going to discover anything important about the determination of human reactions must first have developed a certain character of human reaction for himself. If this is to be used against him when he claims validity for his discoveries, it is a sort of stone he can return with some effect, whoever his opponents may be.

Yet it is extraordinarily important that the experimental psychologist should not be exclusively concentrated upon the particular reaction which he is specifically studying. Just because it is the intact subject, the intact organism, that we are concerned with, the conditions of any reaction are

apt to branch widely. The problem for us, for example, is not to find out how the eye sees or the ears hears, but how the animal and man do. No doubt we can answer this problem only in an imperfect way, but it takes us no nearer perfection to cut the ear or the eye out of the man. This is true with increasing force as we go higher in the level of response. Indirect cues are neither to be ignored, nor to be cut out, but definitely to be studied.

Secondly, no experimental psychologist must profess, with unvarying belief, the dogma of constancy of objective conditions. If, biologically speaking, human reactions had been built up to meet a series of unchanging environments, emphatic insistence upon rigidity of conditions would be justifiable. Obviously, they are not so built. So far as the psychologist is concerned, many of the most important characters that dominantly set the course of our reactions belong directly to the organism with which he is dealing, to its immediate and remote past history and to its present specific and general state of adaptation.

In the third place, the position which I have stated carries with it that the experimental psychologist, at the end of his studies, has to be satisfied with indicating trends, directions, proclivities rather than dogmatic laws. His phenomena are essentially biological, in process of development, displaying no hard-and-fast boundaries anywhere. He may formulate dogmatic laws, and use experiments as imperfect illustrations; but this is the wrong order of things, though it has been by far the commonest and is still the easiest.

Finally, there is the question of the relation of the results of specific experimentation to the claims of general systematic theorising. I am not for one moment for the haphazard experiment that has no idea, no broadly formulated problem, behind it. Also I would condemn that scatter of descriptive results, unco-ordinated, unsystematised, which is common in many directions nowadays. We must explain our results and not merely collect and exhibit them. Yet I would urge that when we have, for example, satisfactorily stated the conditions of some particular perceptual reaction, we have no more right to pronounce magisterially upon a complex problem of reasoning than a physiologist who has studied respiratory functions has to pretend at once to clear up the secrets of spinal reflexes. No doubt the physiologist would never for a moment attempt to do this, but unfortunately it is not so easy to answer for the pretensions of the experimental psychologist in a like case. It may even be that all our specific studies will lay bare common broad principles of the determination of response. Even so, the broad principles are not the explanation of the specific problem, and for whatever they may be worth, before we erect them into a comprehensive system, we must have the specific problems widely and patiently worked out.

Obituary.

SIR E. RAY LANKESTER, K.C.B., F.R.S.

EARLY in the year 1879 I received a letter from the eminent comparative anatomist, Kitchen Parker, advising me to come over to Cambridge to take Francis Balfour's course of lectures in comparative embryology. I sailed from New York two days later, and by far the leading personal impression of my life was in meeting Francis Balfour in the great court of Trinity College, Cambridge. At this first moment he seemed to me a superman, and the impression was continually strengthened during the frequent and ever memorable contacts in lecture room, laboratory, afternoon bicycling trips, and evening dinners in Balfour's rooms. On these weekly occasions he was wont to invite two or three of his students, including William B. Scott and myself, to meet sympathetic colleagues of his from London, Cambridge, and Oxford. Among the latter I recall especially young Oscar Wilde, who was just beginning to attract attention; Henry N. Moseley, fresh from the *Challenger* voyage; and E. Ray Lankester, then professor of zoology and comparative anatomy at University College, London.

This fortunate early acquaintance with Lankester ripened into a lifelong friendship, sustained in more recent years by active correspondence and interchange of ideas. I was never able to induce Lankester to visit America, because, as he freely confessed, there was one thing in the world which he hated and dreaded, and that was a sea voyage—probably from unhappy experiences in crossing the English Channel which undoubtedly hurt his pride as a physiologist and anatomist! But on every occasion when I returned to England I eagerly refreshed my personal acquaintance with him, spending delightful hours in his rooms in Chelsea, partly recalling our Cambridge days but more frequently discussing the newer phases of our knowledge of the ascent of man revealed by the discovery of the rostro-carinate flints along the shores of East Anglia. It was probably Lankester who suggested this highly appropriate name for these 'beak-keeled' implements found by J. Reid Moir of Ipswich.

I consider Lankester's warm support of Reid Moir's excavations and his courageous advocacy of the *human origin and manufacture* of these primordial flints, against the incredulous and indifferent attitude of the reigning archæologists of the day, one of the most striking evidences of his independence of judgment and of his powers of observation. He loved to handle the few specimens of these flints of East Anglia and of Piltdown, Sussex, which he kept in his home, and he forcibly and often vehemently championed their authenticity. On one very salient point we always differed; namely, on the geological age of the rostro-carinates. He steadily insisted that they were Pleistocene, while I maintained that they were Pliocene, a distinction with a very important difference.

As the last survivor of the great group of Victorian zoologists and a veteran of many scientific and geological contests, Lankester represented all the ardent convictions and intensities of feeling

which have now given way to the placid contemplation of past controversies and a lack of intense conviction and even personal animosity over differences of scientific opinion and interpretation. On the occasion of my last visit to Chelsea, in the summer of 1926, he flared up on a theological question and vividly recalled to my mind the heated arguments of the period when I first had the privilege of meeting him in Cambridge. Overcoming his advancing physical infirmity with characteristic courage, Lankester gave up attendance at gatherings in which he was wont to be a gladiatorial leader, but the fires of his intellectual, scientific, and moral intensity burned as brightly as ever. Next to Huxley he was the most combative zoologist of his age, and next to Huxley the most ardent disseminator of the truths of Nature. While violent and even uncompromising in controversy and in his opinions and estimates of other men, on the other side of his nature was a delightful spirit of romance, tenderness, and warmth of affection which endeared him to all his closer friends.

In the passing of Sir E. Ray Lankester we have lost one of the great figures and forces in the zoology and biology of the nineteenth century.

HENRY FAIRFIELD OSBORN.

UNIVERSITY COLLEGE, London, celebrated its centenary last year, yet Sir Ray Lankester succeeded the first professor of zoology—Robert Grant of Edinburgh. Grant had many pupils of eminence, including Sir Michael Foster, but his brilliant early promise was not fulfilled, and waned before his death into insignificance. Ray Lankester suddenly and swiftly made the zoological lecture-room one of the most noted places in the College. It was said that he was the only man in London who could hold his lectures at one o'clock, the sacred luncheon-hour, and have them crowded. His lecture-room, and Balfour's at Cambridge, were the two foci from which the new views on morphology and evolution were spread through the academic world, and his *Quarterly Journal of Microscopical Science* was the organ of publication for the researches—now classic—which were going so swiftly, and apparently so surely, to complete Darwin's work.

Lankester's lectures were astoundingly perfect. Three days a week, at one o'clock, the lecture-room was lined with wall-diagrams, made under Lankester's direction and often from his own drawings, and hung on the wall in appropriate order by his skilful coadjutor Jessop (happily still with us). Every seat was filled, and one or two women students were allowed to listen, unseen, in the gallery. The professor entered—a powerful, resolute, confident figure, with strong black hair and muscular torso. He looked round the diagrams, surveyed us (as we felt, somewhat as if we were cockroaches), and gave for an hour a clear consecutive account of forms and conceptions wholly new to us, with such skill that we were unconscious of the marvellous scope and concentration of his lectures, and unconscious of difficulty in the subject. At the same time, apparently without effort, he drew on his many blackboards with firm sweeps of wide lines clear diagrams, which were left untouched during the day for those who had been unable to copy as quickly as he drew. I have no recollection of seeing him refer to notes except to dictate the definitions of groups, or rarely for some drawing.

For us in 1881, Lankester was infallible, yet his lectures set us arguing and theorising and longing to advance knowledge. "The reproduction of *Euglena* is not known", he said in one lecture; "this is not because there is any impossibility of knowing it, but because it has not been observed. Any one of you may find it out by carefully watching and examining a glass of water containing *Euglena* for twenty or thirty hours, and if you write down your observations they will be read with interest by every zoologist in Europe". He told us of one important discovery by the patience of an unknown amateur and of another important discovery through accident, and breathed into us the passion for advance of knowledge which informed his life.

GEO. P. BIDDER.

THE influence of so prominent, so highly cultured, and so energetic a naturalist as Sir Edwin Ray Lankester could not fail to have an important effect in his day, especially as the value and extent of his own original labours covered so wide a field, namely, from Protozoa to Vertebrates. Since his early paper on the developmental history of the Mollusca, with its twelve quarto plates, zoologists felt that here was a brilliant colleague, and his subsequent career more than justified the opinion, not to allude to the able men such as Benham, Goodrich, Willey, Sydney Hickson, Robt. Gunther, and others trained under him.

In every field he entered Lankester left his mark; and with his facile pen and pencil extended our knowledge of Nature and her ways. To the last he resolutely fought for the early introduction of the study of Nature in the school curriculum, and for the liberal treatment of natural science and its workers by our legislators. No man had a wider influence in spreading the knowledge of biological science amongst the public; indeed, his labours in this respect—from first to last—call for grateful remembrance. His fascinating lectures, and his attractive popular articles in various channels, rendered him, perhaps, the best known zoologist of his day, whilst his familiarity with physics and chemistry enabled him to add breadth to his views. His influence spread to the medical profession by his suggestive papers on *Trypanosoma* and other dangerous tropical pests, on Pasteur and hydrophobia, and on centenarianism.

Lankester's life-long interest in marine zoology culminated in the establishment of the important Plymouth Marine Laboratory, and few know of the minute study he made previously of the only British Marine Laboratory and its surroundings along with Prof. Hubrecht and Mr. (now Sir) A. G. Bourne. Lastly, as Director of the Natural History Departments of the British Museum,

chief editor of the *Journal of Microscopical Science*, and bearing other responsibilities, he worthily held the most prominent position of his day in biology, and the loss of so capable a man and so genial a friend is deeply felt. W. C. M'INTOSH.

SIR W. BALDWIN SPENCER, K.C.M.G., F.R.S.

THIS is written away from books and other aids to memory, and must be taken for what it is, not a biographical sketch but rather an appreciation. Baldwin Spencer graduated at Exeter College, Oxford, and has for many years past been one of our honorary fellows; so I was in the way of seeing him whenever he was in England. Again, on a visit to Australia with the British Association in 1914 I had the chance of observing him at work among the countless treasures with which his explorations had enriched the Melbourne Museum.

About his personality I need say no more than that Spencer himself was more inspiring even than his books. He had all the traits of the first-rate man of science—faithfulness to fact, cool and penetrating judgment, hatred of humbug and half-truths, and, above all, a forcefulness and courage that made him not only conceive noble schemes of research but also carry them out at all costs to a finish. Alas! his own end among the rigours of Tierra del Fuego is proof enough of an intrepidity verging on recklessness. I had a letter from him written from that desolate spot very shortly before his death, in which there is not the slightest hint of danger ahead, and every word betrays the enthusiasm provoked by the prospect of good hunting. Though his voyage out in a cargo-boat (on which he had to sign on as purser to get a passage) cannot have been altogether luxurious, he makes light of it. Indeed, his only complaint, if it can be reckoned one, is that the Argentine authorities insisted on his maternal cognomen being tacked on to the paternal 'Spencer'—a fact that reminds him, he says, of the fact that the matrilineal system is not confined to aboriginal Australia.

Now as to the inspiration that all of us have received from Spencer's books. It is no exaggeration to say that "The Native Tribes of Central Australia", when it appeared in the late 'nineties, gave a new orientation to social anthropology. The biologist of the Horn Expedition of 1894 to the Central region had soon discovered that nothing among the rest of the fauna could compete in interest with man, and, fortified by the local knowledge of Mr. F. J. Gillen, had produced a monograph that exhibited Stone age mentality as something almost *sui generis*, so utterly did its processes differ from those of civilised humanity. Soon Sir James Frazer had got to work on the new facts, and it would scarcely be unfair to say that for him, henceforth, primitive man meant first and foremost the Arunta. So it was with the rest of us. I have numerous letters of that period from Andrew Lang which—though he by no means saw eye to eye with Sir James Frazer on questions of theory—are equally obsessed with the Central Australians as the real thing at last, the human prototype as near as we shall ever meet him in the flesh.

Spencer's further accounts of the North-Central tribes and of those of Northern Territory proved no less sound, if a little less startling, since they revealed what were essentially the same conditions—namely, totemism and a type of cult which some would call magic, others rudimentary religion, the two in close conjunction and permeating every department of the native life.

It may be added by way of testimony to the conscientiousness of Spencer as a man of science that recently he has revised his whole study of the Arunta, correcting linguistic slips and more especially seeking to make allowance for the fact that Gillen and he were in closer touch with one part of the tribe, or rather nation, than with the rest—the total result, however, being to confirm the fundamental accuracy of the original presentation. His works will survive alike on account of their unique contents and because they are models of scientific method. A great man has passed away suddenly, even tragically. But, mourning him, his many friends will be consoled to think that what he wrought will not pass away; for he wrought as a master. R. R. MARETT.

WE much regret to announce the death at Washington of Mr. Emile Berliner, one of the inventors of the microphone and the inventor of the gramophone. Born in Hanover on May 20, 1851, Berliner migrated to America in 1870 and became a salesman in Washington, and it was there in 1876 that he began experimenting with Bell's recently invented telephone. The following year, almost simultaneously with Edison, he brought out his device for varying the electric current by varying the pressure between two contact points, and many years later the Supreme Court of the United States declared Berliner to have been the original inventor of the transmitter. Berliner's next notable invention was the gramophone. Edison's phonograph, patented in 1878, included wax cylinder records cut by an engraving tool which rose and fell—the 'hill and dale' method. Berliner employed discs which were engraved by a tool which vibrated from side to side—the 'lateral cut' method. His patent was taken out in 1887, and his original machine was exhibited in the Franklin Institute on May 16, 1888; it is now in the National Museum, Washington. Berliner also devoted himself to the improvement of the acoustic properties of public buildings, and in 1907 brought out a revolving cylinder internal combustion engine for aircraft.

WE regret to announce the following deaths:

Dr. T. J. I'A. Bromwich, F.R.S., formerly fellow and prælector in mathematical science at St. John's College, Cambridge, and University lecturer in mathematics, on Aug. 24, aged fifty-four years.

Prof. S. B. Schryver, F.R.S., professor of biochemistry at the Imperial College of Science and Technology, on Aug. 21, aged sixty years.

News and Views.

THERE appears to be no end to the difficulties which beset zoological nomenclature. No sooner has one set of decisions been issued than zoologists are invited to send to the International Commission their opinions regarding a new batch of recommendations. The most recent recommendations are proposals made for changes in the International Rules for Zoological Nomenclature, but the proposals are so numerous that they cannot all be circulated, and zoologists must, if they so desire, consult many of them either in scientific journals in which they have appeared, or in manuscript at the office of any of the Commissioners. The circular issued by the Secretary to the Commission gives no hint as to the weight laid upon the opinions of zoological societies or private zoologists by the Commissioners who receive them, but the general impression made by the propositions for revisal is that there is a fairly widespread dissatisfaction with the rules as they stand or as they have been applied.

IT is impossible even to indicate here all the suggestions that have been put forward for the revision of zoological nomenclature, but two of very general interest may be referred to. The proposal is made that the starting-point of zoological nomenclature should be the twelfth edition of Linnæus, and not the tenth edition as at present. In our opinion, the adoption of the tenth edition was a blunder, but whether it is possible now to undo the evils that have arisen from that false step and the acceptance of many papers printed in the transitional stage from 1758 to 1766 which it made necessary, is a question demanding the most careful consideration. A second proposition of great significance paves the way for a more strict definition of papers which may be accepted for purposes of priority in zoological nomenclature. It is essential that no dubiety should exist as to what constitutes acceptable 'publication', and that freak publications should be ruthlessly barred. If the recommendations here made have the effect of confining attention to genuine papers of scientific intention and import, they will help to clear the somewhat cloudy air of zoological naming.

IN view of complaints which we understand have been made by fishermen in Scotland regarding the damage caused to fishing gear and to food fishes by seals, the "Report on the Seals and Sea Lions of California", issued by the Californian Division of Fish and Game (1928), is of more than usual interest. The complaints made in California are similar to those made in Scotland: that the animals are very numerous, that they are increasing in numbers, and that they take enormous quantities of fish of economic value and cause considerable damage to gear. The very extensive investigation made by the Division of Fish and Game shows that the complaints are, to say the least, much exaggerated. The only satisfactory method of deciding the exact nature of the food is by examination of stomach contents, and this has shown that the food consists of great variety, some of the animals containing only squids and octopods, while the great bulk of the food of the others consisted of coarse fish not used commercially. Of thirty-five seals examined in one instance, only two "contained food items in kind or quantity worth considering with respect to their direct bearing on the fishing industry". With regard to the damage to gear the evidence was also unsatisfactory, most of it being vague and circumstantial. The conclusion reached here was that although a certain amount of damage appears to be done to gear, it did not appear to be very extensive, and a good deal of the damage credited to sea-lions and seals may well have been caused by other creatures.

THE full scientific staff for the British, Australian, New Zealand Antarctic Research Expedition under the leadership of Sir Douglas Mawson has now been selected. Counting the leader the number will be 13, making with the master and crew of the *Discovery* a total of 40 souls. Dr. W. Wilson Ingram (Sydney) an 'old contemptible' with a distinguished war record, has been appointed medical officer. Mr. Marr, who has been on the *Discovery* in a former expedition, and Prof. Harvey Johnston, of the University of Adelaide, will be senior zoologists, assisted by Mr. H. O. Fletcher of the Australian Museum, Sydney, and Mr. Falla of New Zealand. The two latter will specialise in taxidermy. Mr. A. Howard, of the University of Melbourne, will be responsible for chemical work, and Mr. R. G. Simmers of the Meteorological Office, Wellington, New Zealand, for meteorological observations. Instructor Commander H. Moyes has been seconded by the Australian Navy to act as survey officer, while the Australian Air Force is providing two aviators in Pilot S. Campbell of H.M.A.S. *Albatross* and Sergeant Douglas of the Flying School, Point Cook. Petty Officer Williams has been appointed in England as echo-sounding and wireless expert, and Mr. Frank Hurley, well known for his work in the War zone, in the Antarctic, New Guinea, and elsewhere, will be official photographer and kinematographer. The master of the vessel is Captain J. K. Davis, and the crew has been selected almost entirely in England. The whole Expedition, therefore, is a fine example of British team work. Besides the contributing governments and the many firms which have donated gifts of food and clothing, Mr. MacPherson Robertson of Melbourne has made £10,000 available to meet the costs of the Expedition. It is anticipated that the *Discovery* will reach Cape Town early in October and take on board the contingent from Australia which will arrive in the s.s. *Nestor*. The vessel will then proceed to Kerguelen and, after coaling, sail to the Antarctic.

ON more than one occasion we have directed attention to the fine progress made by the museums of the United States in catering for the needs of youth. The Field Museum of Chicago, founded in 1893 by a donation of 1,000,000 dollars from Marshall Field, afterwards supplemented by a further 8,000,000

dollars bequeathed on his death, has always kept the interests of children in the foreground, and now publishes a pamphlet, "Field Museum and the Child", dealing with these activities. Free admission to the museum is granted to children and their teachers on all days, but this passive policy is supplemented by many extramural efforts. Portable exhibits, numbering 1000, on natural history and economic subjects, are sent into the class-rooms. Lecturers are sent to the schools to give illustrated talks on subjects studied by the children in their classes, and to direct attention to exhibits in the museum which further illustrate these subjects. Still other work of this nature is carried on within the museum building itself, and includes the direction of the child's explorations in the treasure house of knowledge, the correlation of museum studies with schoolroom work, and the supplementing of museum exhibits with lectures, moving pictures, and lantern slides. Attractive printed stories in souvenir form, based on the lectures and pictures, and on related material in the museum, are distributed to child visitors.

THE paragraphs in our issue of Aug. 17 (p. 274) on museum co-operation have brought a letter from Dr. Marie C. Stopes referring to the Portland Island Museum, of which she is honorary director. This museum is now being established on the island of Portland to preserve specimens of the biological and the palæontological riches of the island, and also records of the island's history. The museum is already housed in the oldest cottage on the island, the freehold of this and some land adjacent having been given; the money for its restoration to its original appearance has been collected almost entirely by the islanders themselves, and the local urban district council has made the necessary arrangements to take over the Museum when complete. The Museum is badly in need of exhibition cases, and Dr. Stopes asks the authorities of the larger museums where wooden cases are being replaced by metal ones to bear in mind the needs of the Portland Island Museum.

The Empire Marketing Board has approved a capital grant not exceeding £30,000 to be devoted to research on Empire timbers at the Forest Products Research Laboratory at Princes' Risborough, under the Department of Scientific and Industrial Research. This grant arises out of a recommendation made by the Imperial Economic Committee in its report on timber, in which it was suggested that the marketing of Empire timbers might be considerably furthered if the Princes' Risborough station could be enlarged so as to include the testing of woods from the Dominions and Colonies as part of its normal routine. Although the Empire can supply an unrivalled variety of fine timbers suited to almost every purpose from its two million square miles of forest land, at present nine-tenths of our imported woods come from foreign sources. A lack of exact information concerning the technical qualities of the various Empire timbers and their potential uses is, it is felt, largely to blame for their restricted use and it is with the object of assisting to fill in this gap that the grant has been made. The station will, when so enlarged, undertake the examination of new Empire timbers to obtain an indication of their possible uses. It will further test their seasoning characteristics, determine their strength values, carry out woodworking trials to ascertain their machining and finishing qualities, and, in general, carry out both routine and special work on woods from Empire sources. An Empire Timbers Committee is also being set up under the Department to advise the Princes' Risborough Laboratory on the priority to be given in the choice of timbers for test and in other calls on its services.

THE question of the standardisation of the voltage of supply for electric lighting and power is at present being seriously considered by electrical engineers. It is found that the householder hesitates to purchase domestic electric appliances, thinking that if he ever wants to change his neighbourhood the new pressure of supply will probably be different, and so the appliances he is thinking of purchasing would have to be scrapped. Some years ago, the British Electrical Standards Association (BESA) fixed the standard voltage of supply in Great Britain as 230, a voltage which was approved by the Electricity Commissioners. Unfortunately, the number of stations that supply at 230 volts is still in a minority, and the cost of changing over the pressure of supply of all the stations in the country would be greater than 20 million pounds. All kinds of pressures are in use, varying between 100 and 250 volts, but most of the stations supply at pressures not less than 200 volts. The lack of standardisation in the early days of the industry, when each consulting engineer paid little attention to the pressures already in use, is now beginning to hamper progress, and consumers supplied at freak voltages pay more for their lamps. Other nations have the same trouble. In a recent journey abroad we noted that the pressures of supply marked on the lamps in the bedrooms of the hotels at which we stayed were as follows: Chantilly, 250; Avignon, 210; Cavalière, 230; Aosta, 150; Locarno, 135; Geneva, 130; Troyes, 125; Le Touquet, 110; and at Calais the lamps were marked 125-130. Apparently, therefore, the need for standardising pressures is also urgent abroad.

A LEAFLET recently published describes the "Scientific and Technical Positions in the National Bureau of Standards of the United States" and how they are obtained (Washington, D.C., U.S. Government Printing Office). All positions on the staff are subject to the competitive requirements of the civil service regulations. Every candidate, therefore, must qualify through a civil service examination. Applicants, however, for higher grades are not subjected to a written examination, but are rated on their education, experience, and writings. They must be citizens of the United States. The advanced courses at the Bureau are accepted by several universities as credits towards a higher degree. Junior assistants are offered the opportunity of continuing their college work at local universities; in fact, employees in the lower grades are expected to prepare themselves by study for higher grade positions.

Educational facilities are also afforded by the weekly meetings of the staff, co-operative courses of study, and by lectures from visiting scientific workers. The salaries range from 600 dollars, that of a junior messenger, to 9000 dollars, which is the annual salary of the heads of the professional and administrative departments respectively. Stress is laid on the amenities of the site of the laboratory. The buildings are arranged like a university "on a natural hill amidst beautiful country surroundings" and only about 3½ miles from the centre of Washington. To show how attractive the life is, the facilities for many outdoor sports, including polo and skating, are mentioned. We are told also that the Potomac River is much used for canoeing and swimming, and that its banks are suitable for camping and 'hiking'.

ACCORDING to the Report of the United States National Research Council for the year July 1927–June 1928, which forms part of the Report of the National Academy of Sciences for the same period, the expenses for the year were £170,000, 35 per cent of this being for the support of research fellows, 33 per cent for research in charge of committees of the Council, 13 per cent for research in charge of other organisations, and 19 per cent for general maintenance and charges. The funds for the fellows come from the Rockefeller Foundation and the General and International Education Boards, those for general maintenance from the Carnegie Corporation, and the rest from other sources outside the Council as set out in detail. The fellows number 18 in physics, 25 in chemistry, 15 in mathematics, 25 in medicine, 43 in biological sciences, and 49 in child development. The Report extends to 95 pages, and 20 pages of it are devoted to short accounts of the work done in each of these divisions and 4 pages to details of expenditure.

WE have received the annual programme of the Belfast Naturalists' Field Club, together with some additional information, and have been impressed by the liveliness of this field club, which has celebrated its sixty-seventh session by electing its first lady president, Miss W. J. Sayers, and by reaching a membership of one hundred in its well-conducted Junior Section. The total membership having reached 585, a limitation has been put upon the number of new members; the new rule provides for the election of twenty-five new members in each half-year and elections only at the two specified meetings. Although still a very long way from the 180,000 membership of the Gesellschaft der Naturfreunde in Stuttgart, the Belfast Field Club appears to be one of the most active naturalists' clubs in the British Isles.

THE Gorgas Memorial Institute of Tropical and Preventive Medicine, initiated in memory of General Gorgas, who did so much for the eradication of yellow fever in Cuba and Panama, is now in operation. The object of the Institute is to conduct an intensive campaign against unnecessary sickness and premature death, and to carry on research in tropical diseases at the Gorgas Memorial Laboratory established in Panama. The United States Congress has voted 50,000 dollars annually for maintenance, and it is expected that the countries of Latin America will also contribute.

THE Minister of Health having considered the report of a Committee appointed to inquire into vaccination in Great Britain, has decided to amend the Vaccination Orders so as to give effect to some of the recommendations, which are briefly as follows: (1) In place of the officially advocated four insertions, trial to be made of vaccination and re-vaccination in one insertion, with a minimum of scarification; (2) primary vaccination to be performed in infancy as at present, and re-vaccination to be offered at school-entering and school-leaving ages; (3) vaccination in multiple insertions to be still available for persons who may desire it; and (4) in public vaccination, if after-treatment be required as a consequence, it is the duty of the public vaccinator to provide such attention without cost to the parents. (Ministry of Health: Circular 1025a, and "Statutory Rules and Orders", 1929, No. 640, London: H.M. Stationery Office.) The new order comes into operation on Oct. 1.

THE Secretary of State for Scotland and the Minister of Agriculture and Fisheries have appointed the following committee "to investigate the origin, predisposing causes, and mode of dissemination of furunculosis and similar infectious diseases among salmon, trout, and other freshwater fish in England and Scotland, and to conduct experiments with a view to ascertaining methods of combating the diseases": Prof. T. J. Mackie (chairman), Prof. J. A. Arkwright, Mr. T. E. Pryce-Tannatt, Mr. J. C. Mottram, Mr. Douglas Johnston, Mr. W. J. M. Menzies. The secretary of the Committee is Mr. William Martin, of the Fishery Board for Scotland, 101 George Street, Edinburgh, to whom communications should be addressed. A series of epizootics of furunculosis among salmon and trout in Great Britain in recent years has been sufficiently extensive to occasion considerable damage to valuable fisheries in the rivers affected. A smaller committee has already made preliminary investigations, and several reports have been issued on the scientific work which has been undertaken and on the specimens which have been taken in the areas of infection and examined. A most important result which has been established is that apparently healthy fish may act as carriers of furunculosis, and the relationship of this fact to the incidence and spread of the disease among home and imported fish will form one of the considerations to be investigated by the new Committee.

THE tenth Annual Report of the Ministry of Health, 1928–1929, has been issued. The subjects dealt with fall under the main heads of public health, local government and finance, administration of the Poor Law, and administration of National Health Insurance and Contributory Pensions. The report of the Chief Medical Officer of the Department is issued separately. The remarks on canal boats by the Inspector, Mr Owen J. Llewellyn, are of some general interest. Few boats now make short journeys, and individually owned and worked boats are to-day the exception. Mr. Llewellyn's experience is that canal boat-people are solicitous for their children's welfare and look after

them properly; the schools are far better attended than once was the case, and parents and children are increasingly anxious to take advantage of them. He sees no reason why children and families should not live on the boats, and the decent, kindly, and healthy status of the boat-people as a whole is a proof that there can be little wrong with their mode of living.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chief lecturer in pharmacy and an assistant lecturer in pharmacy at the Swansea Municipal Technical College—The Director of Education, Education Offices, Dynevor Place, Swansea (Sept. 3). An officer in the Mechanical Engineering Department and one in the Transportation (Power) Department of the Indian State Railways—The Secretary, Services and General Department, India Office, Whitehall, S.W.1 (Sept. 14). An assistant professor in mechanics and mathematics at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, S.W.7 (Sept. 30). A director of the Agricultural Research Institute, Pusa, India—The Under Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1 (Nov. 29). An expert adviser in animal husbandry under the Government of India—The Under Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1 (Nov. 29). A junior scientific officer in the Admiralty Scientific Pool at the Experimental Establishment, Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A road engineer for the Public Works Department of the Government of Cyprus—The Crown Agents for the Colonies, 4 Millbank, S.W.1. A water engineer for the Public Works Department of the Government of the Tanganyika Territory—The Crown Agents for the Colonies, 4 Millbank, S.W.1. Teachers for evening instruction in chemistry and physics, mechanics, mechanics and heat, engineering calculations, and machine drawing at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. An assistant physicist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Station, Waldegrave Road, Teddington.

Our Astronomical Column.

Orbits of Neujmin's and Forbes's Comets, *b* 1929 and *c* 1929.—The following orbits have been computed of Neujmin's comet *b* 1929, and Forbes's comet *c* 1929. The equinox is 1929·0, *T* is in U.T. The second and third are parabolic orbits.

	Neujmin.	Neujmin.	Forbes.
I	1929 July 3·57	1929 April 16·64	1929 May 26·149
ω	144° 21′·73	116° 29′	234° 32′
Ω	157 17·64	154 29	29 34
i	3 56·57	5 9	5 37
ϕ	36 39·76	—	—
log q	0·32426	0·3312	0·18927
Period	11·983 years	—	—
Computer	M. Ebell	Bower and Willis	H. E. Wood.

The small inclination of Forbes's comet suggests that it may be periodic. The calculated position of this comet from Wood's elements for Aug. 3·75 is R.A. 20h 53m 40s, S. Decl. 30° 26′. The position telegraphed for that date was 20h 0m 52s, S. 30° 26′. The telegraphed R.A. appears to be in error.

Ephemerides for 0h U.T. from the first and third orbits:

NEUJMIN'S COMET.

	R.A.	S. Decl.	log r.	log Δ.
Aug. 27.	21h 8m 2s	14° 36′	0·3357	0·0732
Sept. 2.	21 7 10	15 0	0·3382	0·0863
8.	21 7 1	15 19	0·3410	0·1014
14.	21 7 41	15 35	0·3441	0·1186
20.	21 9 16	15 44	0·3474	0·1369

FORBES'S COMET.

	R.A.	S. Decl.	log r.	log Δ.
Aug. 29.	20h 54m 6s	27° 45′	0·3025	0·0258
Sept. 2.	20 55 6	27 15	0·3097	0·0462
6.	20 56 24	26 44	0·3172	0·0671
10.	20 58 0	26 13	0·3244	0·0877
14.	20 59 54	25 42	0·3312	0·1084
18.	21 2 5	25 10	0·3382	0·1288

It will be seen that the two comets are fairly near each other. Their magnitudes are about 14½ and 12 respectively.

The Puzzle of the Major Planets.—The above is the title of an article by Prof. H. N. Russell in the *Scientific American* for August. He refers to the change of view as to the condition of the four outer planets that has taken place in recent years. It was previously believed by many astronomers that their low densities indicated high temperatures; but the radiometric measures at Flagstaff and Mount Wilson indicate that their outer layers are very cold, probably at least 100° C. below zero. The difficulty is to identify the gases forming these outer layers. We have the two clues of the rich and varied colours that are visible on the disc of Jupiter, and the series of bands in the spectrum which grow stronger in proportion to the distance from the sun, being weak in Jupiter's spectrum and very pronounced in that of Neptune. Menzel's suggestion that they are due to some compound or allotropic form which is stable only at very low temperatures, is mentioned with approval. The temperature of the outer layers may be presumed to decrease as the distance from the sun increases; this would account for the increasing prominence of the bands for the more distant planets. A suggestion by Prof. Moulton is quoted that the low density of the giant planets is due to their having retained great quantities of lighter materials which the smaller planets lost through their weaker gravitational attraction. It is natural to postulate the presence of large quantities of hydrogen and helium in their outer envelopes. The suggestion is also quoted that Jupiter and Saturn may be covered with frozen oceans 11,000 miles in depth. It is difficult to reconcile this hypothesis with the evidence for the presence of energetic action at great depths in their atmospheres, which is afforded by telescopic study of their discs.

Argon in the Solar Corona.—A suggestion was recently made by I. M. Freeman attributing many of the unidentified coronal lines to argon (see also NATURE, Jan. 19, p. 106). This theory is criticised by Prof. H. N. Russell and Dr. I. S. Bowen, who show, in the *Astrophysical Journal* (vol. 69, p. 196), that the number of coincidences is very little larger than might be expected from pure chance (within the wide limits of error allowed by Freeman). Also, discordances for some of the better-measured lines exceed the limits of observational error. It is concluded that "the attribution of the coronal lines to Argon is without foundation".

Research Items.

Garo Ethnology.—Dr. Biren Bonnerjea publishes in the *Indian Antiquary* for July a study of the Garo, an aboriginal tribe of Assam who inhabit the Garo Hills, which are named after them. Their ethnical affinities are doubtful; their customs peculiar. They are probably a section of the great Bodo tribe which at one time occupied a large part of Assam. They speak a language of the Bodo group of the Tibeto-Chinese family. They have small round faces, are platyrrhine, and have blue eyes and dark skins. Language and physical features suggest Mongolian stock, a view supported by the frequent occurrence of the blue Mongolian patch on the sacral region. They are essentially agriculturists, but are omnivorous. It is suggested that fire has only recently been introduced among them, as they eat their food raw or only slightly warmed. Each family has two habitations, one in the village and one in a tree. They believe in a supreme anthropomorphic god who dwells, with wife and children, in heaven. The children were born on earth before the god and his consort took up residence in heaven, and the Garos are descended from one of three granddaughters. This legend must be connected with the prevalence of mother kin. The Garos worship a number of minor deities and are animists. Hence all grave goods buried with the dead are broken, that they, too, may be dead and their 'souls' may serve the dead in the next world. The cult of the heavenly bodies, especially of the sun and moon, is practised. Periodically the sins of the community, which have accumulated throughout the year, are expelled by means of a scapegoat—an animal. The great sacrifice of the year takes place after the harvest, when the headman supplies all taking part with a pig and an abundance of liquor. The central figure is a 'horse' of straw borne by a man, which is the centre of the dance lasting all night. At the end of the ceremony the body of the horse is thrown into a stream and the head is preserved until next year. A meal is then taken by the side of the water. Mother-right prevails and the people are exogamous. The marriage ceremony is unusual, as it is the bridegroom who is captured. Polyandry is unknown; polygyny exists in theory but is rare.

Fertility Figures.—Two examples of the remarkable carved stone human figures known as Sheela-na-Gig are described and figured in *Man* for August. The Sheela-na-Gig has been regarded as a fertility figure, a relic of paganism surviving into Christian times. Of the two here mentioned one, described by Miss M. A. Murray, is from the Priory Church, Hexham. It is one of a number of sculptured figures on the north side of the screen of the chantry of Prior Rowland Leschman, and is dated at about 1480. The figure, which is at the centre of the lower of two rows of sculptures, is a three-headed phallic personage with hairy legs, riding on a creature with cloven feet, lion's ears, human features, and a large protruding tongue. One of the three heads is a human skull. The second figure described is from the church of St. Michael-at-the-North-Gate, Oxford. Until recently it was one of the stones of the tower, but it has now been removed to the interior of the church to protect it from the effects of a smoky atmosphere. The stone, which is some twelve inches square, is hollowed out to form in relief the rudely carved figure of a woman, a typical Sheela-na-Gig. There is no known record of the figure nor of its position in the tower. The age of the tower is disputed, though for certain reasons about 1071 is suggested. The figure may be much older, though no settlement at Oxford before the eighth century is known.

Codling of the North Sea.—Mr. Michael Graham, in his paper "A Study of the Growth-Rate of Codling (*Gadus callarias* L.) on the Inner Herring-Trawling Ground" (Ministry of Agriculture and Fisheries, Series 2, Vol. 11, Nos. 2-3, 1928: Studies of Age Determination in Fish, Parts 1 and 2. London: H.M. Stationery Office, 1929. Part 1, 6*s*. net; Part 2, 3*s*. 6*d*. net.), continues his researches on the cod. This work, which is part of a general scheme of research on the North Sea cod, was undertaken in order to ascertain the age at which the codling enter commercial catches. The method employed was based almost entirely on scale reading and length of fish. Reproductions of all scale tracings are included in an appendix with the serial number and length of fish. For the scale readings the author's precise method relating to the first winter ring, described in his former paper (1926), is used. Assuming that the first narrow ring and the second wide band, as defined by him, are the first winter ring and second summer ring respectively, and also assuming that the fish investigated were hatched in the middle of March (the height of the spawning season in these regions), such assumptions being justified by the facts shown, it is concluded that the modal length of the codling in the Inner Herring-Trawling Ground was 20 cm. at two years and 29 cm. at three years of age. The present research only applies to the first three years of the cod's life, when it is still immature. The value of scale reading and all its difficulties are fully discussed, and the fact is accentuated that although the scales for the most part record the true age of the fish, there is usually a certain number of misleading scales which are, however, always in the minority. A correct majority is almost certain, and the author is of the opinion that the method is valuable provided that there is a majority of fish of one year class, or, in a mixed sample, if one is justified in assuming that the apparent year classes are real. In Part 2 a detailed survey is given of the literature, embodying all the most important work on the subject, with summaries and criticisms. This is a most helpful guide to the large amount of matter which has accumulated during the last thirty years.

Keeping and Rearing Marine Invertebrates.—Lieferung 278 of Dr. Emil Abderhalden's "Handbuch der biologischen Arbeitsmethoden", Abt. 9, "Methoden der Erforschung der Leistungen des tierischen Organismus", Teil 5, Heft 3, 1928, treats of the methods of rearing, of management in captivity and in research of the Cephalopoda, Echinodermata, Bryozoa, and of *Bonellia*, *Thalassema* and *Echiurus*. Dr. Georg Grimpe gives an account of the care, management and breeding of various cephalopods for zoological and physiological purposes. These mollusks are specially useful to the naturalist and physiologist, many of them occurring in large quantities. They are, however, usually extremely difficult to keep alive, especially the deep sea forms, although *Sepia*, *Octopus* and *Eledone* can be kept for some time in aquaria, *Sepia* feeding mainly on prawns and shrimps, *Octopus* and *Eledone* on crabs. Although the eggs of most species are well known, they are difficult to rear and no instance is as yet known of one being reared from egg to adult. It is, moreover, still uncertain what is the natural food of the young *Loligo*. A table of breeding seasons of the commoner species from various localities is given, which in the light of further knowledge could be much extended, at any rate from the Plymouth district. John Runnström deals with the rearing of echinoderms; he discusses the methods of fertilisation and of rearing the larvæ of many forms

n most cases successfully carried on until after metamorphosis, methods with which the names of Mortensen, MacBride and many others mainly connected with the Plymouth Marine Laboratory are associated, including the feeding of the larvæ with *Nitzschia* cultures devised by Allen and Nelson. A short account of keeping Bryozoa by Heinz Graupner includes the feeding of adults and larvæ; and finally there is an interesting chapter by F. Baltzer on *Bonellia*, *Thalassema* and *Echiurus*, in which researches, chiefly by the author on *Bonellia*, are described, relating to the small male which lives inside the uterus of the female, and the rearing from the egg of both sexes.

Studies on Tadpoles.—Dr. G. K. Noble (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, art. 7, 1929) describes the eggs and tadpoles of the toad *Hoplophryne uluguruensis* from the Uluguru Mountains of East Africa. The eggs are laid within the stems of bamboos which have been split sufficiently to permit the entrance of the toad. The tadpoles produced from the eggs live either in the bamboo stems or between leaf and stalk of banana plants, and are either exposed to the air or crowded into small basins of water. Lungs are functional at the time of hatching; no external gills ever appear, and the internal gills are reduced to a few minute villosities on a single branchial arch. A pair of cutaneous flaps—apparently locomotor—moved by special branchial muscles, develops in the hyoid region. The epidermis of these flaps is thickened and its surface is toothed—like that of the adhesive discs of tree frogs. The tadpoles agree with those of *Hyla* in Jamaica in feeding on frogs' eggs, insects, and vegetable matter, in having comparatively large and powerful jaws and a short digestive tract. Dr. Noble has also examined a large series of well-preserved tadpoles of the frog *Staurois ricketti* from Fukien, China. These stream-dwelling tadpoles have just behind the mouth a suctorial disc bearing along its posterior edge a crescentic area of tuberculated epidermis which functions as a friction surface. The muscles attached to the disc may be readily homologised with those found in the tadpoles of *Rana*. Mature tadpoles of *Staurois*, unlike certain other mountain brook tadpoles, have reduced lungs. Increased oxygen content of mountain-stream water is one of the factors permitting lung reduction in the Amphibia which live in these waters.

Leeches from Sarawak.—J. Percy Moore (*Proc. Acad. Nat. Sciences*, Philadelphia, vol. 81, 1929) describes a small collection of leeches made in the mountainous interior of Sarawak, British Borneo. The collection is chiefly of land and tree leeches; only one aquatic leech, *Hirudinaria*, is included. A new genus, *Gastrostomobdella*, is established for one of the terrestrial or amphibious Erpobdellidæ which has a large ventral pore opening into the stomach at segment xiv/xv. The pore leads into a Y-shaped canal, the median limb of which extends vertically for about a third of the body thickness and then bifurcates symmetrically. The branches diverge widely and open into the floor of the stomach at its anterior end and its extreme lateral margins. The author suggests two possible functions of this canal: (1) that at the time of copulation a spermatophore is implanted in the pore and the sperms pass through the epithelium lining the canal to the ovisacs where fertilisation takes place; (2) that the pore acts as a sort of preliminary anus for the elimination of earth from swallowed earthworms after these have been crushed in the pharynx. The gut pore is entirely undeveloped in small specimens. The presence of chætæ of earthworms in the rectum indicates that this leech is a burrowing predaceous form. Three species of land leeches of the genus *Hæmadipsa* are recorded—two are subspecies of the dull-coloured *H. zeylanica*; the third has a yellow stripe along each side of the body and is described as a new species—*H. picta*. Its bite is said to be painful and difficult to heal.

Resistance of Limnæidæ and their Allies to Desiccation.—The periodical drying up of pools is one of the natural ways in which the destruction of disease-carrying mollusca is effected, and Dr. Cawston in 1927 appears to have advocated its artificial adoption as a means of controlling bilharzia infection. He has since conducted a series of experiments with the view of ascertaining for what length of time molluscan carriers can resist desiccation or burial (*Trans. Roy. Soc. Trop. Med. and Hyg.*, vol. 22, No. 4). These investigations took place at Durban in the winter months under conditions representing the greatest degree of drought which these freshwater snails would be likely to experience in Nature. Experiments in drying confirmed experience that the animals of closely coiled shells like *Planorbis* can survive desiccation for several days, thus showing greater resistance than those occupying more loosely coiled shells like *Limnæa*, *Physopsis*, or *Bulinus* [=*Isidora*]. One of the Ancylidæ survived a whole winter without water, apparently attached to a rush. The effect of light varies: *Limnæa* prefers light to darkness; *Bulinus* and *Physopsis* are indifferent; whilst *Planorbis* prefers the dark. Burial offered some interesting results. *Limnæa natalensis*, Krauss, the common carrier of *Fasciola gigantica*, soon dies if buried in garden soil at a depth of two to twelve inches. *Physopsis africana*, Krauss, the common carrier of the Natal schistosomes, can survive for at least twelve days at a depth of two inches, but dies after being buried twenty-five days. *Planorbis pfeifferi*, Krauss, an occasional carrier, will live for at least thirty days at a depth of twelve inches and probably will survive the whole winter in the dried mud of pools. *Bulinus tropica*, Krauss, readily survives thirty days buried at a depth of twelve inches, and is thus well able to resist the periodic drying of South African vleis. *Tiara tuberculata*, Müller, being an operculate, survived burial for thirty-seven days. The author concludes that the complete drying up of pools for short periods is of limited value only.

Effect of X-Rays on Living Cells.—The researches undertaken by Strangeways on methods of tissue culture and on the effects of X-rays upon the living cells in such cultures, were really an offshoot from his original aim, the investigation of the problems of rheumatoid arthritis, but have now assumed great importance as a technique for the investigation of the effects of radium and X-rays upon living tissues. A summary of the work already carried out and in progress has recently been given by S. F. Cox and F. G. Spear (*Brit. Jour. Radiol.*, vol. 2, p. 222; 1929). Strangeways and Oakley found that after exposure to X-rays there was a latent period during which no change in the cells was observed: this was followed by a decrease in the number of mitoses—an observation confirmed by Strangeways and Hopwood—with, later, granular changes and breaking down of the cells. In the case of fowl embryos, X-rays produced death by arrest of the circulation owing to blocking of the vessels with clotted blood; the tissues could recover when cultivated *in vitro*. In very young embryos, however, before establishment of the circulation, exposure was not lethal, recovery occurring on further incubation. Canti, working with Donaldson and Spear, found that radium also inhibited mitoses provided that the intensity of radiation was above a certain threshold. So long as the dose was not lethal,

recovery occurred with a rise in the number of mitoses above that in the control cultures, the increase compensating exactly for the fall originally observed. The bearing of these researches upon the problems of the treatment of malignant disease by radium and X-rays need not be emphasised, quite apart from the light shed upon questions of cell physiology.

Chromosomes and Magnets.—The similarity between the arrangement of chromosomes during cell division and the arrangements of magnets floating in a confined space has long been noticed. The rather scanty data on this subject have been considerably extended by Yoshinari Kuwada and his co-workers in a series of nine papers (*Mem. Coll. Sci., Kyoto Imper. Univ.*, B, **4**, pp. 199-369). The arrangements of different numbers of floating magnets and the effect of using magnets of different sizes are described, while the nature of the complicating factors is discussed. Cytological data as to the nuclear figures in various plants and the albino rat are given for comparison. In general, about two-thirds of the division figures agree with those observed on magnets.

Serpentine in Southern Rhodesia.—*Bulletin* No. 12 of the Geological Survey of Southern Rhodesia (" The Shabani Mineral Belt ", by F. E. Keep, 1929) is of more than local interest, for it contains discussions on the origin of serpentine, of chrysotile asbestos and of the other associated fibrous minerals, with an explanation of the remarkable alteration of all these minerals to talc. The area is one of Basement Schists, south-east of the Wezda Platinum Mine on the ' Great Dyke ', penetrated by a dunite-serpentine complex which in turn was followed by intrusions of gneissic granite. The magmatic gases and vapours which were emitted from the granitic magma in the later stages of its consolidation entered the joint planes of the dunite and caused serpentinisation. After cooling, serpentine in solution continued to be deposited, forming chrysotile asbestos in the fracture planes through which the solvent made its way. Afterwards, intense shearing took place accompanied by the emission from the granite of siliceous waters charged with carbon dioxide. In these circumstances, serpentine became converted into talc and talc-carbonate rocks. Success has already been achieved in applying these theoretical results to the location of workable chrysotile lodes.

Chart of Wave-lengths.—Mr. J. A. Vogelmann, 165 Broadway, New York City, has published a chart showing the immense range of wave-lengths of various forms of radiation that have now been brought within the scope of observation. He gives it an extension of 170 octaves, of which only a single octave is appreciable by the eye in the form of light. The longest waves used in wireless telegraphy are near one end of the scale, and the very short ' Millikan ' cosmic rays are at the other. The wave-lengths are arranged in the form of a spiral on the diagram, but the latter is so crowded with figures and letterpress that it is not too easy to follow. The author has made the mistake of giving uselessly long sequences of significant figures for the number of vibrations per second for different rays. The method of giving a few figures multiplied by a power of ten is far more convenient. He has included earthquake and sound waves, though these belong to different series, also the waves supposed by some writers to be the cause of gravitation, a theory that is far from being generally accepted. In a second edition of the chart the descriptive portions have been rewritten and extended; but it still has the defect that much space is occupied by long rows of useless and meaningless digits. Where the wave-length is only given to two significant figures there is no point in giving the number of vibrations per second to 25 figures.

Raman Spectra of Sulphates.—Part 4 of volume 3 of the *Indian Journal of Physics* contains a short paper by Messrs. S. K. Mukerjee and P. N. Sen Gupta, of the University of Dacca, on the Raman spectra of sulphuric acid and the sulphates. The method used is that of Wood, which allows good photographs to be obtained in an hour, with a Cooper-Hewitt lamp of 2000 candle power and a Hilger spectrograph. In the case of the sulphates of magnesium, sodium, and copper in solution in water, the mercury line 4047 A. excited a line 4214 A., and the line 4358 A. a line 4552 A. The two excited lines imply an absorption line for sulphates at 102,000, while Coblenz found it at 92,000. For sulphuric acid the same mercury lines excite lines at 4140 A., 4203 A., 4433 A., and at 4464 A., 4538 A. respectively. These correspond to absorption lines at 46,500, 110,000, and 182,000, while Coblenz found 95,500 and 113,500 only. Other salts are to be investigated.

Neon Isotopes.—The May issue of the *Proceedings of the Imperial Academy of Japan* contains a paper by Prof. Nagaoka and T. Mishima on the fine structure of the line spectrum of neon. On cooling a neon tube in liquid air, to reduce the thermal broadening of the lines by the Doppler effect, and then analysing the light from it by an interferometer used in conjunction with a prism spectrometer, the fringes were found to be doubled. One set, which was strong, presumably came from the abundant isotope of neon of mass 20, and the other, a feeble set, from the rarer isotope of mass 22. The separation of the lines is greater than would be expected from the simple theory of the difference in Rydberg constant for isotopes, although the discrepancy is less than with other isotopic elements. Prof. Nagaoka makes the interesting suggestion that the addition of two protons and two electrons to the Ne^{20} nucleus to produce the Ne^{22} nucleus may have made an important difference to its magnetic properties, basing his remark upon a certain similarity between the isotopic displacements of various lines and their Zeeman effects.

Asphalts.—The complex hydrocarbon called asphalt, used in road construction, is, when it is natural and not a residue of petroleum distillation, obtained from certain lakes, the most important being Trinidad Lake, on the Island of Trinidad in the British West Indies, and the Bermudez Lake, near Guanoco, on the eastern coast of Venezuela. Asphalt was obtained from lakes and used by the ancient Babylonians, and Herodotus describes a lake in Zacynthus from which he himself saw pitch obtained by means of bundles of twigs. In the issue of *Chemistry and Industry* for Aug. 9, J. S. Miller contributes an interesting illustrated article on the production and refining of native asphalt. The lakes are full of asphalt, that at Trinidad being probably the crater of an extinct mud volcano. The asphalt is dug out with mattocks, refined by heating to drive off the water which it contains, and then drawn off into barrels. It may be ' fluxed ' by mixing with petroleum residue to make it suitable for road work, refined asphalt being too hard for this purpose. All asphalts contain sulphur in a combined condition, and sometimes an asphalt is heated with sulphur to remove some hydrogen as hydrogen sulphide. This sulphur treatment raises the melting-point and lowers the ductility. The article indicates that the chemical composition of asphalt and even its physical properties are still only imperfectly known.

The British and French Associations at Havre.

In connexion with the annual congress of L'Association Française pour l'Avancement des Sciences, held at Havre towards the end of July, the members of the British Association not taking part in the South Africa meeting were invited to attend. In addition, facilities were given for the Conference of Delegates from Corresponding Societies of the British Association to be held, the president for the meeting being Dr. F. A. Bather. Sir Henry Lyons and Mr. T. Sheppard were elected by the Council officially to represent the British Association, and in the absence of Dr. Tierney, Mr. Sheppard acted as secretary for the Conference for the Havre meeting.

The French Association, though on a smaller scale, is organised on similar lines to that of the British Association, and has its sections, though the numbers attending the sectional meetings suggest that probably papers of more general interest to a larger audience would have been more desirable to the French Association in view of its present membership.

Our French confrères issued a Bulletin in connexion with the Association's fifty-eighth year, containing various items of information; also a journal with particulars of the excursions, list of officers, etc. A volume entitled "Le Havre", and another "Normandy", were presented to each delegate, and facilities for visiting different places were given.

The sections were devoted to mechanics, astronomy, geodesy, mathematics, navigation, aeronautics, civil and military engineering, physics, physical and general meteorology, geology and mineralogy, botany, anthropology, medical sciences, radiology and medical electrology, pharmaceutical sciences, experimental psychology, biogeography, agronomy, geography, political and statistical economy, pedagogy, hygiene and public health. In addition to papers read under these various headings there were conferences on "Le Problème de l'Hérédité tuberculeuse", and "L'Orientation professionnelle et l'Apprentissage". Excursions were arranged to Honfleur. Sunday was devoted to an excursion to Fécamp, where a monument to Dr. Leon Dufour was unveiled, and at the conclusion of the meeting excursions were made to Grouville, Lisieux, Caen, Bayeux, Mont St. Michel; and to Rouen and its neighbourhood.

The conference commenced with the presidental address of General Perrier, and in the evening a reception was given by the Municipality of Havre at the Hôtel de Ville. There was a visit to the port, showing its facilities for dealing with traffic, and the members were shown round one of the large liners. There was an official visit to the Museum at Havre, the specimens being described by the Curator, Dr. Loir; also a ceremony at the French War Memorial, when a wreath was placed thereon by Sir Henry Lyons on behalf of the British Association, and another at the cemetery occupied by English soldiers, when General Perrier presented a wreath on behalf of the French Association.

With regard to the British section, rooms had been placed at the disposal of the Conference of Delegates in the Hôtel des Sociétés Savantes. This was originally intended to be the meeting place of the Conference of Delegates, but on account of the difficulty in darkening the rooms the actual conference was held at the Lycée de Garçons. In the former rooms, however, were exhibited a collection of photographs of archæological interest taken from the air, kindly lent by Mr. O. G. S. Crawford of the Ordnance Survey, and a representative series of maps illustrating regional survey, showing various aspects of the Croydon district, kindly supplied by Mr. C. C. Fagg. The room was also decorated with a selection of the British Association banners which were sent at the special request of our French friends. The banners had been selected on account of their historical interest, and were as follows: York 1831, Edinburgh 1850, Aberdeen 1859, Bath 1864, Norwich 1868, Liverpool 1870, Edinburgh 1871, Montreal 1884, Liverpool 1896, Bristol 1898, Manchester 1915.

There were nearly a hundred representatives at the Conference of Delegates, including both French and English members. Dr. Bather was in the chair, and there were delegates from fifteen British societies. The chairman regretted the death during the year of Sir George Fordham, who was well known in Havre, and had originally been proposed as president for the Conference. The chairman then called upon Mr. T. Sheppard, who referred to the assistance received from Dr. A. Loir at the previous conference at Havre in 1914, and to the honour conferred upon Dr. Loir by the University of Glasgow at the British Association meeting last year, when he received the degree of doctor of law, and Mr. Sheppard asked Dr. Loir to accept on behalf of some of his friends, members of the British Association, the cap, hood, and gown which he was entitled to wear. Dr. Loir returned suitable thanks for the mark of esteem.

On the suggestion of the French Association, the principal subject for discussion at the Conference was the scientific aspects of the Channel tunnel, a paper illustrated with slides being read by Mr. E. O. Forster-Brown on the subject. After carefully reviewing the question, Mr. Forster-Brown concluded that: (1) The existing geological evidence is favourable; (2) further geological evidence should be secured preparatory to designing the work and estimating its cost; (3) the construction of the tunnel is likely to result not only in material benefit to the parties constructing it, but it will strengthen still further the amicable relations existing between England and France. Mr. Forster-Brown's paper appears *in extenso* in the *Colliery Guardian* of Aug. 16 and 23.

A communication was received from Prof. P. F. Kendall, the last survivor of the many British geologists who in the eighties of the last century were consulted as to the possibility of a tunnel under the Channel. Prof. Kendall has kept in touch with the subject, and his observations were made partly in the way of encouragement and partly as a warning. Having reviewed the percentage of days of rough weather on the Channel, and the questions of air transport, a train ferry, and a bridge, respectively, he concluded that a tunnel seems to be the only form of transit likely to be satisfactory. He is satisfied that the engineers will be able to overcome any difficulties provided they keep in touch with the geologists, who have a knowledge of the strata and the peculiar conditions which obtain. Prof. Kendall urged further soundings. He pointed out that "On the English side the official geological map is at present undergoing revision, during which it may be expected that attention will be paid to the tectonic structure. The existing map, however, shows that the Cretaceous rocks are subject to such changes of level between the coast at Folkestone and the great breach of the escarpment at Wye as to show that it must be affected by considerable folds; not only so, but at Beachborough, 5 miles from the coast, a fault occurs which completely severs the Gault outcrop and must consequently have a displacement of more than 100 feet. There is no reason, as far as can be seen, why the 30 miles of submarine outcrop should differ materially

from comparable lengths of outcrop in France and England respectively, and it behoves those upon whom the duty falls of laying down the line of the tunnel, to take these probabilities into account." Generally speaking, Prof. Kendall seemed to think that there are more difficulties than had been assumed by most of his predecessors, but that they are not unsurmountable, and in any case he is strongly opposed to the suggestion that a tunnel might be made in the Gault under the chalk. This paper will appear *in extenso* in the *Naturalist*.

Afterwards the chairman, Dr. Bather, addressed the delegates as to the value of their annual conference and asked for opinions to be expressed with regard to its future working. He called upon Mr. T. Sheppard, the vice-chairman of the Corresponding Societies' Committee, who has been associated with the Conference for many years, to give his views on the matter, after which many of the delegates spoke.

At the final session of the French Association, under the presidency of General Perrier, medals which had been specially struck were presented to those who had been conspicuous in assisting the Congress, the names of the recipients being in relief. Sir Henry Lyons, director of the Science Museum, London, and Mr. T. Sheppard, who acted as local secretary for the Havre meeting on behalf of the British Association, each received one of these medals.

At the concluding banquet, held at the Hôtel Frascati, representatives of the different countries sending delegates were 'toasted', and members from Belgium, Portugal, Spain, and Great Britain each spoke in turn, Mr. Sheppard representing the British Association.

Welsh Bygones.

IN view of the plea for the institution of a national folk-museum for England which appeared in NATURE of Aug. 24, p. 289, it may not be out of place to describe here briefly what has already been done in the National Museum of Wales at Cardiff on similar lines to preserve the evidences of the arts and industries of the Welsh people in post-Reformation times.

The collections for the most part are at present housed temporarily in a gallery which was specially built for the purpose in 1925; but adequate and permanent accommodation will be available when the eastern range of galleries now in course of erection is completed. At the moment 1294 objects are actually on exhibition, but a number are still in store. The exhibits cover a very wide range; and they also include a certain amount of material from England and Ireland. This has been judged necessary not only for purposes of comparison, but also because England for centuries has supplied Wales with such articles as her pottery and most of her cutlery. Many of the articles are dated, and thus, in illustrating the history of the arts and crafts in Wales, they also provide a basis for a systematic chronology for Welsh bygones.

The arrangement of the exhibits has been carried out so far as possible with due regard to their original purpose, but the limited space available makes complete logical arrangement difficult and in some cases impossible. So far as may be, groups have been kept together. Thus, on passing from the entrance hall of the Museum, where are the Eisteddfod chairs, the stocks, pottery, folklore objects and other exhibits of special interest, the first cases in the Bygones Gallery contains kitchen appliances, followed by table ware and then laundry appliances. Then comes a block of exhibits showing dairy appliances and agricultural implements. These are succeeded by the implements and appliances of various industries, such as mining, spinning and weaving, lace-making and knitting, trapping and fishing and transport. Then follow exhibits relating to the horse and the various crafts. Furniture, costumes and personal ornaments, important sections, necessarily occupy a considerable amount of space. The ecclesiastical, economic, and social life are well illustrated by a varied and wide range of objects. Dress, in particular, includes a valuable collection of richly ornamented eighteenth-century costumes from Tredegar Park. These, of course, are additional to the well-represented peasants' costumes. Objects related to the Eisteddfod naturally figure largely. They include manuscripts, Druid's chairs, and the 'wooden book'—squared wooden sticks in a frame, invented by the Glamorgan druids—harps, etc., and other musical instruments.

Among the objects illustrative of Welsh folklore are rags from wishing wells and a large and valuable collection of 'love-spoons'. The 'love spoon', it may be explained, was a carved wooden spoon which was presented by the lover to the object of his affections. Originally it was merely a wooden copy of a metal spoon, but it became highly elaborated. Another folklore object of great interest which the Museum is fortunate enough to possess is a 'Mari Llwyd' from Llangwynyd, Glamorgan. The 'Mari Llwyd' corresponds to the 'hooden horse' of Thanet and elsewhere. The 'Mari Llwyd', like the 'hooden horse', is a horse's skull and jaws sheeted and adorned with coloured ribbon, streamers, etc. The sheet completely covered a man who carried it at the head of a procession at the Christmas and New Year festivities. In Wales its use was afterwards transferred to May Day. It would be out of place to discuss its origin and meaning here; but though the authorities of the National Museum accept the derivation that it was a substitute for the ass of the medieval miracle and mystery plays, it is more probably a fertility symbol of much older date.

Owing to considerations of space, the collections with two exceptions have to be exhibited under museum conditions, that is, in cases and on walls. The exceptions are the kitchen and bedroom furniture and appliances. Two recesses in the galleries have been utilised to give these objects their natural setting in a typical Welsh kitchen and a typical Welsh bedroom. Here are the fireplace, turnspit, cooking utensils, dressers with crockery, clocks, chairs, etc., the bed, mattress and bedding, the coffer, press, Bible and deed boxes, candles and so forth, in the conditions in which they were actually in use.

A well-illustrated guide to the collections, with an introductory account of Welsh life and culture by Mr. Iorwerth C. Peate, assistant curator, has recently been published by the National Museum of Wales, Cardiff (price 1*s.* 6*d.*).

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Agriculture and Forestry has appointed Mr. F. H. Garner, of Clare College, to be University lecturer in agriculture, and Mr. A. S. Watt to be University lecturer (Gurney lecturer) in forestry.

The following University lecturers have resigned their offices: Mr. P. Sergeant Florence, Caius (economics); Mr. S. Lees, St. John's (engineering); Mr. R. V. Southwell, Trinity (mathematics); Dr. D. R. Hartree, St. John's (physics); Mr. A. Amos, Downing (agriculture); Mr. R. L. Manning, Jesus (geography).

Mr. W. S. Mansfield, Emmanuel, has been appointed Director of the University Farm.

An industrial bursary has been awarded by the Royal Commissioners for the Exhibition of 1851 to Mr. H. V. Rose, Jesus College, to enable him to undertake an apprenticeship with the British Thomson-Houston Company, Limited.

The Trustees of the Busk Studentship in Aeronautics have awarded the studentship for the year 1929–30 to Mr. S. G. Hooker, of the Royal College of Science, London.

THE City and Guilds of London Institute's report for 1928 shows a further small decrease in the number of students in the City and Guilds (Engineering) College, which reached its maximum in 1921–22. Since that date there has been a continuous decline in the enrolments in the mechanical engineering and motive power department, and this has been only partially counterbalanced by an increase in the electrical engineering department. The number of students from India (28) has increased largely in the past two years. A noteworthy event of the year was the establishment of a Maybury chair of highway engineering as a result of an offer made by a joint committee of the Paviors' Company and of the Institution of Municipal and County Engineers. The Institute's Department of Technology reports an increase in the number of candidates examined from 14,205 to 16,048, including an increase in the number of those examined at centres overseas from 1788, the previous maximum, to 1878. The new scheme of handicraft examinations (metal and woodwork) lately brought into force led to the entry of more than double the former number of candidates for the First, while the entries for the Second Handicraft Examination, held for the last time under the old scheme, also nearly doubled.

THE report of the United States Commissioner of Education for the year 1927–28 (Washington, D.C.: Government Printing Office, pp. 42, price 5 cents) is by Dr. J. J. Tigert, an old Rhodes scholar, who held the office of Commissioner for the seven years 1921–28. It comprises (1) a review of recent events in public education, and (2) a report on the work of the Bureau of Education, of which the Commissioner is the head. In the field of higher education, prominence is given to a recent judicial decision declaring to be unconstitutional an act of the legislature of the State of Minnesota which would have usurped the rights and powers of the governing body (Board of Regents) of the University of Minnesota. This decision ensures a professional rather than a political development of the educational policies of the University. Attention is also directed to events indicative of "an awakened consciousness of the supreme value of the library in modern methods of college instruction", of increasing systematisation of research and graduate work, and a tendency towards the affiliation of small or junior colleges with larger institutions or with groups. Investigations have shown anew the neglect of the teaching of physiology and hygiene in secondary schools and colleges. There has been a steady increase, however, in the number of high schools giving instruction in sex hygiene, the tendency being to make it a part of more general courses, such as biology or physiology, and to give less emphasis to disease. The Bureau's work is essentially an intelligence service, and in no country in the world is education better served in this respect. The list of educational researches and surveys by its staff is impressive. Its library division maintains useful bibliographies, indexed and cross-referenced, of research studies in education throughout the United States.

Calendar of Patent Records.

September 1, 1585.—The patent granted by Queen Elizabeth to Thomas Wilkes for twenty-one years on Sept. 1, 1585, for the manufacture and importation of salt, which conferred on the patentee a virtual monopoly of the salt trade on the east coast of England, was one of the chief grievances raised in the monopoly debates in the Parliament of 1601. In spite of the terms of the grant, which provided for an adequate supply of salt at a cost not exceeding that prevailing in London, John Smith, to whom the patent was assigned in 1599, raised the price from 14 pence to 14 shillings a bushel, and thus provided a case for the House of Commons that could not be ignored. The patent was voided with other similar grants by Royal Proclamation.

September 3, 1893.—Otto Lilienthal, an aeronautical pioneer to whose enthusiasm and perseverance the successful evolution of the aeroplane owes a great deal, patented his glider machine in Germany on Sept. 3, 1893. Lilienthal made more than two thousand attempts at flight with his various machines, and finally succeeded in gliding for distances of 200-300 yards. In his earliest gliders, stability was obtained by movements of his own body, but later he added steering gear to the machine, and it was while experimenting with this in the air in 1896 that he met his death.

September 4, 1841.—The chain-grate mechanical stoker, practically in the form in which it is known to-day, was introduced by John Juckes, who obtained an English patent for the invention on Sept. 4, 1841. The first installation was erected the following year at the works of Messrs. Easton and Amos in Southwark, and not only showed a saving in the consumption of coal of about 10 per cent, but also, by enabling a poorer quality of fuel to be used, permitted a still greater reduction in the cost. Though the invention was extensively adopted, Juckes died in poverty. (Cf. Calendar of Patent Records, May 24.)

September 5, 1877.—The successful application of compressed air for working a system of secondary clocks from a standard clock was the invention of the Viennese engineer, Carl Albert Mayrhofer, who applied for his German patent on Sept. 5, 1877. In his earliest arrangements, the controlled clocks received impulses, through small leather bellows, once every minute from the standard clock, but in later forms they had ordinary going trains, and the positions of the hands were corrected and the main springs re-wound at set hours. The invention attracted a good deal of notice at the Paris Exhibition of 1878, and the systems were installed in public buildings in Vienna and Berlin, and on a larger scale in the streets and shops of Paris.

September 6, 1831.—The 'miners' safety fuse' of William Bickford was patented on Sept. 6, 1831. The fuse was almost at once adopted by the British Government for military purposes, and by the mining industry, and resulted in a very large reduction in the number of blasting accidents.

September 6, 1834.—Of the many inventions made by General Henry Shrapnel, the best known is the artillery shell to which his name has been given. Shrapnel shell was first used at the capture of Surinam in 1804, and its success was immediate, the range being four or five times that of the case-shot which it replaced. No patent was taken out for the invention, but Shrapnel received an annuity of £1200 from the Government and one of £200 from the East India Company, and would have received a baronetcy if William IV. had not died before he could confer it. Shrapnel's only patent is dated Sept. 6, 1834, for improvements in the sighting apparatus and other parts of fire-arms.

Societies and Academies.

PARIS.

Academy of Sciences, July 22.—**Ch. Gravier** and **J. L. Dantan**: New observations on the sexual stolons of *Syllis* (*Haplosyllis*) *spongicola*, a polychætal annelid. The sexual organs are not really acepalous, but the stolons are often broken off. The antennæ are not rudimentary, but are very long.—**T. Buscheguennce** and **S. Rossinski**: The deformation of stratifiable congruences.—**J. Haag**: Extension of the method of Résal-Caspari for the deformation of the spiral. The elastic suspension of pendulums: a rectification of priority.—**D. S. de Lavaud**: New possibilities of flight with one motor stopped on aeroplanes with two motors.—**G. Poivilliers**: Fitting negatives into apparatus of restitution.—**C. Marie** and **C. Haenny**: Study of the ammonia-oxygen gas battery. The element consisted of air–platinum–pyrex glass–platinum–ammonia, and was heated to temperatures of 500°-790° C. The e.m.f. observed was of the order of 1 volt, corresponding to the value calculated from thermochemical data, assuming the reaction to be $4NH_3 + 3O_2 = 2N_2 + 6H_2O$.—**A. Poirot**: The emission of anode rays of sodium and chromium. Statement of the conditions necessary for stability in the emission of anode rays of sodium and chromium from sodium bichromate.—**Albert Arnulf**: A method for the determination of angles by the utilisation of microscopic areas. The method described is capable of measuring the angle between the faces of a microscopic crystal, the dimensions of the faces not exceeding 0·001 mm.—**Josef Hrdlicka**: A method for the measurement of the effective clearness of photographic objectives.—**P. Lambert** and **J. Lecomte**: A recording spectrometer for the infra-red. A device for recording photographically the deviations of the galvanometer needle when actuated by a thermocouple moved across the spectrum: in twenty minutes an automatic record is obtained, giving results which would require half a day's work by the visual method.—**Paul Queney**: The spectra of phosphorus and arsenic in the extreme ultra-violet. Multiplets of As IV. and As V.—**V. Posejpal**: Fluorescence and infra-red absorption.—**Pierre Leroux**: Study of the absorption of a crystal of dialogite.—**Edgar Pierre Tawil**: The vibrations along the optic axis in an oscillating piezo-electric quartz. According to the laws given by Curie, the deformations of a quartz crystal placed in an electric field are produced along the electrical axis and in a direction normal to this axis and the optic axis. The dimension along the optic axis should remain unchanged. The results of the author's experiments appear to establish the existence of vibrations in the direction of the optic axis.—**A. Tian**: The heat of solidification and heat of solution of saccharose.—**J. Perreu**: The determination of the limiting heat of solution of some hydrated salts (direct method).—**J. Loiseleur**: The polarisation of membranes under the action of plates of metal.—**Louis Rapkine**: The potential of an inert electrode in a solution of acetaldehyde.—**Emile Rousseau**: The oxidising action of sunlight on an oil solution of zymosterol. The oxidation of zymosterol (extracted from yeast) under the influence of sunlight is progressive but slow, and less than was obtained in earlier experiments with ergosterol.—**M. Geloso** and **Mlle. L. S. Lévy**: The influence of ammonia on the adsorption of copper or nickel salts. The ammonia concentration has a considerable influence on the adsorption of soluble salts of copper and nickel by ferric hydroxide.—**M. Prettre** and **P. Laffitte**: The oxidation of carbon monoxide.—**Ch. Bedel**: The oxidisability of silicon and its solubility in hydrofluoric acid. It has not been found possible to repeat the experiments of M. Sanfourche proving the increased solubility of silicon in hydrofluoric acid by reason of oxidation to silica.—**A. Travers** and **Schnoutka**: The existence of monocalcium aluminate in solution. Evidence suggesting the existence of a calcium aluminate in solution, derived from the acid $HAlO_2$.—**J. Calvet**: The influence of various salts on the solution of pure aluminium in hydrochloric acid. Salts of platinum, gold, mercury, copper, and nickel were employed; compared with the other metals, the effect of platinum was very marked; 0·21 mgm. of platinum per litre caused immediate attack, and even at a dilution of one in 250 millions, the amount of aluminium dissolved was fifteen times that dissolved by the pure acid in the same time.—**J. Bougault** and **Mlle. L. Popovici**: The reduction of the semicarbazones of the α-ketonic acids.—**L. Palfray** and **B. Rothstein**: Some esters of the 1·4- and 1·3-cyclohexanediols (quinite and resorcite).—**H. Vincienne**: New researches on the structure of the southern part of the Vuache.—**J. Lambert**: The Eocene Echinideæ of Madagascar.—**Henri Piéron**: The laws of establishment of the chroma of light impressions.—**L. Lavauden**: A new Madagascan carnivore of the genus *Eupleres*.—**P. Vignon**: The morphology and evolution of the posterior wing in the Coleoptera.—**H. Gauthier**: The aquatic flora of the Central Sahara.—**Jacques Pellegrin**: An African cave fish with very small eyes. A description of a representative of a new genus of fish found in a shaft at Eil (Italian Migiurtina-Somalia), to which the name *Eilichthys microphthalmus* has been given. The eyes, although much reduced, are still visible externally. This fish is remarkable as being a transition form between the surface Cyprinideæ with normal eyes and the cave forms, completely blind, now known.—**Mlle. M. L. Verrier** and **A. Panu**: The pigment and the chromatic variations of some reptiles of the group of the Agamidæ.—**Jean Painlevé, Paul Wintrebert**, and **Yung-Ko-Ching**: The development of the stickleback (*Gasterosteus aculeatus*) analysed by chronophotography. Protoplasmic contractions and embryonic circulation.—**A. Paillot**: The infectious origin of the micro-organisms of the Aphides.—**R. Fosse, A. Brunel**, and **R. de Græve**: The diastatic transformation of uric acid into allantoic acid. Uric acid is attacked by the juice of various leguminous plants, allantoic acid being produced. It is suggested that this fermentation of uric acid is the result of the action of two ferments, one an oxydase producing allantoin, the other giving allantoic acid by simple hydrolysis.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 9).—**V. Romanovskii**: On the chain of Markoff.—**L. A. Portenko**: The geographic forms of *Prunella atrogularis* and *P. montanella*. Two new subspecies of *Prunella atrogularis* and one of *P. montanella* are described, re-discriptions of the previously known forms also being given.—**K. A. Rassadina**: The lichens of the Vologda province. A list of fifty-one species of lichens collected in the province.

Comptes rendus, No. 10.—**A. P. Vinogradov**: Manganese in insects. Ash of a number of species of insects was found to contain manganese, but ants are particularly rich in this element, the ash of *Formica rufa* containing up to 5 per cent of manganese.—**V. Barovskij**: Description of a new species of the genus *Macrolycus* Waterh. (Coleoptera, Lycidæ). *Macrolycus pubescens*, sp. n. is described from Vladivostok.—**A. Djakonov**: New starfishes from the Okhotsk Sea. (1) *Leptasterias fisheri*, sp. n.—**V. K. Soldatov** and **A. M. Popov**: The new genus *Cyclopteropsis* (Pisces-Cyclopteridæ) from the Okhotsk Sea. The new genus

s allied to *Cyclopteroides* Garman and includes four pecies, namely, *C. macalpini* Paar, *C. cergi* Popov, *. popovi* Soldatov, *C. jordani* Soldatov. — **A. M. 'opov**: A preliminary revision of the Russian mullets.)ne species of *Mugil* and five species of *Liza* are listinguished from Russian waters.—**B. S. Vinogradov**: A new species of jumping mouse (*Scirtopoda ctenodactyla*, sp. n.) from Repetek (Turkmenistan).—**A. I. Argiropulo**: A new subspecies of *Micromys minutus* Pall. (Mammalia, Rodentia) from Central China.—**V. I. Bodylevskij**: The fauna of a bed at Mohn Bay, n the east coast of Spitsbergen. The discovery in hosphoritic conglomerates of Spitsbergen of *Pseudoisceras* cf. *Beyrichi* Schl. and *Lingula* cf. *Beani* Phil. ndicate the affinity of the fauna to that of the Franz oseph's Land.

Rome.

Royal National Academy of the Lincei, May 19.—**. Vinassa**: Ions, electronic numbers and symmetry.—**V. Glivenko**: General forms of the law of high umbers in functional spaces.—**Maria Pastori**: The artially intrinsic representation of tensors.—**G. Vranceanu**: Certain problems of equivalence.—**E. Bompiani**: Hyperspatial surfaces with a double onjugated system (1).—**A. Tonolo**: Classification of urfaces of Hilbertian space the 2-tangent of which s of four dimensions (3).—**A. de Mira Fernandes**: 'ensors associated with a vectorial ennuple.—**G. Viola**: Elliptical elements of the system of W. Ursae majoris.—**D. Graffi**: Some applications of adiabatic invariants o electricity. Various examples are given to show ow adiabatic invariants, which are properties of echanical systems, may be utilised in the treatment f questions relating to electric circuits, these being n various cases governed by differential equations nalogous to those of mechanics.—**L. Tieri** and **V. Ricca**: Electronic emission in a vacuum tube (2). A recent study on the variation of the current serving n incandescent filament *in vacuo* with change in the lectronic current between filament and plate has ow been extended to the case of the pure tungsten lament of a Philips' *E* triode. The inversion of *I* is confirmed, *I* being the filament current. The nterpretation of this behaviour, and the definition f the conditions under which such inversion occurs, re to be discussed later.—**E. Amaldi**: The quantum heory of the Raman effect. The application of Dirac's methods of treating radiation problems to he theory of the Raman effect is demonstrated. 'ormulæ are obtained for the intensities of the Raman ines and the Tyndall light and their ratios.—**E. Fermi**: Quantistic electrodynamics. Electrodynamic equaions are obtained in quantum form, in particular or the case in which there are electric corpuscles with ow velocity in the field. The principal applications f these equations will be given in a subsequent ommunication.—**E. Segrè**: The quantum theory of luorescence. Dirac's methods, with slight modificaions, are applicable to the phenomenon of fluorescence.—**M Federici**: Impedance of a quadripolar transluctor.—**M. Lombardini**: Calculation of the turbulence n the lower strata of the atmosphere.—**G. R. Levi** nd **A. Baroni**: Diethyl pentasulphides. Of the two someric diethyl pentasulphides recently described, ne (I.) boiling at 130° under a pressure of 26 mm. s transformed into the other (II.) boiling at 119°, when heated above 200°. Form I. has the refractive ndex 1·59517 at 13° and the specific gravity 1·1620 t 16°, and form II. the refractive index 1·60269 at 3°, and the specific gravity 1·1687 at 16°. In romoform solution, both modifications produce reezing-point depressions corresponding with the ormal molecular weights.—**G. A. Barbieri**: A new type of rare earth salts. Tervalent rare earth elements, which give neither alums, fluoro-salts, nor cyano-salts, form such salt types as crystalline double nitrates, double carbonates, ferri- and cobalti-cyanides not encountered with common tervalent elements. It is now found that such rare earth elements form also argento- and auri-cyanides of the general formula, $M'''[Ag(CN)_2]_3$.—**Giambattista Dal Piaz**: New observations on the Italian Oligocene.

Sydney.

Royal Society of New South Wales, June 5.—**H. G. Raggatt** and **F. W. Booker**: Notes on the use of the aneroid barometer and plane table in geological mapping. A description of the methods adopted for the accurate employment of the plane table and the correlation of barometric readings during the geological survey of the Hunter River Coalfield, giving details as to geological and topographic features and the construction of a contour map.—**F. W. Booker**: Preliminary note on new subgenera of *Productus* and *Strophalosis* from the Branxton district. Descriptions are given of two new subgenera of Productides, *Wyndhamia* and *Branxtonia*, from the Branxton Beds of the Hunter River Coalfield. This group of fossils is of value for accurate zoning of beds which overlie and have a definite relation to the Greta Coal Measures.—**W. G. Arneman** and **J. C. Earl**: The celluloses of some Australian plants. In view of the abnormality of the cellulose of posidonia fibre, other celluloses from Australian sources have been examined. The standard of comparison used is the optical rotation of the triacetate. Most of the celluloses conform in this respect to the normal type of cotton cellulose. A water weed of *Potamogeton* sp. contains a cellulose which differs from both those of posidonia and cotton, while posidonia leaves contain the same cellulose as the fibre.

Victoria.

Royal Society, June 13.—**Mary D. Glynne**: A note on some experiments dealing with sulphur treatment of a soil and its effect on wheat yield. A plot of land on which wheat has been grown continuously for fourteen years has recently produced very poor crops. Treatment with sulphur, sulphuric acid, both alone and followed by lime, and with ammonium sulphate, resulted in surprisingly large increases in crop. That these results do not depend on pathological conditions is suggested by the small amount and by the distribution of disease organisms. Such possibilities as a sulphur deficiency in the soil or a setting free of compounds limiting growth through increased soil acidity are discussed.

Official Publications Received.

British.

Address on Dynamics of Development, delivered to the Public Questions Society, University of Melbourne, April 1929, by the Chairman of the Development and Migration Commission (Mr. H. W. Gepp). Pp. 18. (Canberra: H. J. Green.)

Development and Migration Commission. Summary of Reports. Lachlan River Scheme, New South Wales, 28th November 1928; Nowingi-Millewa South Railway and Public Works Scheme, North-western Victoria, 14th November 1928. Pp. 24. (Melbourne: Development and Migration Commission.)

Union of South Africa: Botanical Survey of South Africa. Memoir No. 13: The Vegetation of the Riversdale Area, Cape Province. By Dr. J. Muir. Pp. 82+1 plate. (Pretoria: Government Printer.)

Proceedings of the South International Congress of Photography, London, July 9-14, 1928. Editors: W. Clark, T. Slater Price and B. V. Storr. Pp. xiii+571+29 plates. (Cambridge: W. Heffer and Sons, Ltd.) 25s. net.

Discovery Investigations. Second Annual Report, January 1927-May 1928. Pp. 27+3 plates. (London: H.M. Stationery Office.) 1s. net.

Journal of the Chemical Society: containing Papers communicated to the Society. July. Pp. iv+1387-1622+x. (London.)

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1928. Pp. 24. (London: H.M. Stationery Office.) 9d. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1221 (M. 61): The Effect of Stress upon the X-ray Reflections from Tungsten Wire at Air Temperature. By H. L. Cox and I. Backhurst. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 225.) Pp. 4+4 plates. (London: H.M. Stationery Office.) 9d. net.

Home Office. Report on Conferences between Employers, Operatives and Inspectors concerning Fencing of Machinery, Prevention of Accidents, First Aid and Temperature in Cotton Spinning Mills. By Eliot F. May. Pp. 28. (London: H.M. Stationery Office.) 3d. net.

Tenth Annual Report of the Ministry of Health, 1928–1929. (Cmd. 3362.) Pp. xii+238. (London: H.M. Stationery Office.) 4s. net.

Ministry of Health. Maternal Mortality in Childbirth: Ante-Natal Clinics, their Conduct and Scope. (Memorandum 145/M.C.W.) Pp. 7. (London: H.M. Stationery Office.) 1d. net.

Technical College, Bradford. Diploma and Special Day Courses, Session 1929–1930. Pp. 218+26 plates. (Bradford.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 23: Report of the Irish Radium Committee for the Year 1928. By Dr. Walter C. Stevenson and M. R. J. Hayes. Pp. 277-293. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on July 30th, 1929. Pp. 7. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 15: Studies in the Ectocarpaceae. 2: The Life-History and Cytology of *Ectocarpus siliculosus*, Dillw. By Dr. Margery Knight. Pp. 307-332+6 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5s. 6d.

City of Leicester Museum and Art Gallery. Twenty-fifth Report to the City Council, 1st April 1928 to 31st March 1929. Pp. 24. (Leicester.)

Transactions and Proceedings of the New Zealand Institute. Vol. 60, Part 1, March. Pp. iii+204+17 plates. (Wellington, N.Z.) 10s.

Canada. Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1927. (No. 695.) Pp. 186 (6 plates). (Ottawa: F. A. Acland.)

Legislative Assembly: New South Wales 1928 (Second Session). Report (together with Appendices) of the Minister of Public Instruction for the Year 1927. Pp. 36. (Sydney, N.S.W.: Alfred James Kent.) 2s. 6d.

South Australia. Annual Report of the Director of Mines and Government Geologist for 1928. Pp. 8. (Adelaide: Harrison Weir.)

FOREIGN.

United States Department of Agriculture. Farmer's Bulletin, No. 1596: Cattle Grubs or Heel Flies, with Suggestions for their Control. By F. C. Bishopp, E. W. Laake and R. W. Wells. Pp. ii+22. (Washington, D.C.: Government Printing Office.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 21. (New York City.)

Proceedings of the United States National Museum. Vol. 75, Art. 10: A Summary of the Earthworm Fauna of Burma, with Descriptions of Fourteen New Species. By G. E. Gates. (No. 2781.) Pp. 41. Vol. 75, Art. 14: Distribution and Key of the North American Copepods of the Genus Diaptomus, with the Description of a New Species. By C. Dwight Marsh. (No. 2785.) Pp. 27. (Washington, D.C.: Government Printing Office.)

Publikationer fra det Danske Meteorologiske Institut: Communications magnétiques, etc. No. 6: On the Influence on the Composition of the Air of a possible High Temperature in the Highest Strata of the Atmosphere. By Helge Petersen. Pp. 15. No. 7: The Departures of the Daily Means. By V. H. Ryd. Pp. 30. (København: G. E. C. Gad.)

Proceedings of the United States National Museum. Vol. 75, Art. 18: A Synopsis of the Trematode Family Schistosomidae, with Descriptions of New Genera and Species. By Emmett W. Price. (No. 2789.) Pp. 39+15 plates. Vol. 76, Art. 4: North American Species of the Weevils of the Otiorhynchid Genus Mesagroicus. By L. L. Buchanan. (No. 2801.) Pp. 14+2 plates. Vol. 75, Art. 25: Recent Foraminifera from the West Coast of South America. By Joseph A. Cushman and Betty Kellett. (No. 2796.) Pp. 16+5 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 104: The Foraminifera of the Atlantic Ocean. Part 6: Miliolidae, Ophthalmidiidae and Fischerinidae. By Joseph Augustine Cushman. Pp. viii+129+22 plates. (Washington, D.C.: Government Printing Office.)

University of Illinois Engineering Experiment Station. Bulletin No. 193: An X-ray Study of Firebrick. By Albert E. R. Westman. Pp. 13+2 plates. (Urbana, Ill.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 64: Periodische Bahnen um L_4 (bezw. L_5) im Problème restreint bei beliebigen Verhältnis der zwei endlichen Massen: eine vorläufige Mitteilung. Von Elis Strömgren. Pp. 13. (København: Bianco Lunos Bogtrykkeri.)

Department of Commerce: Bureau of Mines. Coke and By-Products in 1927. By F. G. Tryon and H. L. Bennit. (Mineral Resources of the United States, 1927, Part 2.) Pp. viii+595-687. (Washington, D.C.: Government Printing Office.) 15 cents.

Proceedings of the Imperial Academy. Vol. 5, No. 6, June. Pp. xiii-xiv+223-262. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 192: Experimental Studies on Form and Structure of Sparks. By Torahiko Terada, Ukitirô Nakaya and Ryuzo Yamamoto. Part 6: Long Sparks in Organic Vapours. Pp. 271-290+plates 28-34. 50 sen. No. 194: On the Oxidation of Sodium Sulphite by Air in the Presence of Ferrous Hydroxide, and a Theory of Negative Induced Reaction. By Susumu Miyamoto. Pp. 81-92. 20 sen. No. 195: Thermo-electricity of Nickel Wire. By Toshimasa Tsutsui. Pp. 93-110. 30 sen. Supplement, Vol. 11: Spectrophotometric Study of Micas. By Toyosumi Yoshimura. Pp. 4+1 plate. 10 sen. Table No. 3: Tables of $\frac{e^{ax}}{x}$ and $\int_x^\infty \frac{e^{-u}}{u}\,du$ from x=20 to x=50. By Takeo Akahira. Pp. 181-215. 55 sen. (Tokyo: Iwanami Shoten.)

Diary of Societies.

WEDNESDAY, SEPTEMBER 4.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Wimborne), at 11.30 A.M.

FRIDAY, SEPTEMBER 6.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

CONFERENCES.

AUGUST 31 TO SEPTEMBER 6.

NATIONAL VETERINARY MEDICAL ASSOCIATION (at Ayr).—The papers to be read include the following:—Foot-and-mouth Disease, J. O. Powley; Lameness, Prof. J. J. O'Connor; The Mineral Requirements of Farm Animals, Dr. J. B. Orr; Johne's Disease, Major G. W. Dunkin; The Clinical and Epidemiological Aspect of the so-called Hysteria of the Dog, Prof. F. T. G. Hobday.

On Sept. 3 at 1.45 a Popular Public Lecture on Tuberculin Testing, by Prof. J. B. Buxton.

SEPTEMBER 8 TO 14.

INTERNATIONAL CONGRESS OF THE WORLD LEAGUE FOR SEXUAL REFORM ON A SCIENTIFIC BASIS (at Wigmore Hall, Wigmore Street).

SEPTEMBER 9 TO 14.

LIBRARY ASSOCIATION (at Brighton).

Lord Balniel: Presidential Address.

Col. J. M. Mitchell: The Small Town in Relation to the County Library System.

A. Esdaile: The Student Reader and his Books.

Discussion on Cataloguing.

L. S. Jast, W. C. B. Sayers, Mrs. A. H. Radice, Miss Belle Rennie, J. W. H. Brown, and F. A. Hughes: Symposium on Children's Reading.

E. Davis and others: Discussion on Books in Elementary Schools.

SEPTEMBER 9 TO 12.

INSTITUTE OF METALS (at Düsseldorf).

Monday, September 9, at 5.—Dr. A. G. C. Gwyer: Aluminium and its Alloys (Autumn Lecture—in German).

Tuesday, September 10, at 9.30 A.M.

Dr. W. Rosenhain: Some Methods of Research in Physical Metallurgy.

G. Masing: Methods of Research in Metallography.

P. Chevenard, A. M. Portevin, and X. F. Waché: A Dilatometric Study of Some Univariant Two-Phase Reactions.

M. Haas and D. Uno: An Improved Differential Dilatometer.

W. H. J. Vernon and L. Whitby: The Open-Air Corrosion and Surface Patina of Copper.

C. O. Bannister: Studies on the Crystallisation of Gold from the Liquid State.

A. G. Lobley: The Creep of 80:20 Nickel-Chromium Alloy at High Temperatures.

Wednesday, September 11, at 9.30 A.M.

W. J. P. Rohn: Reduction of Shrinkage Cavities and Vacuum Melting.

M. Tama: New Methods for Melting Non-Ferrous Metals in the Electric Furnace.

N. F. Budgen: Pinholes in Aluminium Alloy Castings.

O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of Locomotive Firebox Stays and Plates.

A. von Zeerleder and P. Bourgeois: Effect of Temperature Attained in Overhead Electric Transmission Cables.

Dr. J. Newton Friend: The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part II. The Results of Seven Years' Exposure to Air at Birmingham.

C. Blazey: Idiomorphic Crystals of Cuprous Oxide in Copper.

Thursday, September 12.—Excursions.

SEPTEMBER 10 TO 12.

IRON AND STEEL INSTITUTE (at Newcastle-upon-Tyne).

Tuesday, September 10, at 10.15 A.M.

C. S. Gill: Notes on the Damping-Down and Re-Starting of Blast Furnaces.

A. T. Adam: Notes on Wire for Mining Ropes.

A. Hultgren: Crystallisation and Segregation Phenomena in 1·1 per cent Carbon Steel Ingots of Smaller Sizes.

J. A. Jones: High Elastic Limit Structural Steels.

Wednesday, September 11, at 10 A.M.

J. H. Whiteley: The Coalescence of Pearlite.

H. A. Dickie: The Solubility of Carbide in Ferrite.

T. D. Yensen: Iron-Silicon-Carbon Alloys. Constitutional Diagram and Magnetic Properties.

T. A. Rickard: Iron in Antiquity.

Thursday, September 12, at 10 A.M.

E. G. Herbert: The Hardening of Superhardened Steel by Magnetism: The Lattice Resonance Hypothesis.

E. Diepschlag and F. Wulfestieg: Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to their Temperature and their other Properties.

H. O'Neill: The Hardness of Vacuum-Annealed Crystals of Iron.

J. H. Smith, C. A. Connor, and F. H. Armstrong: The Correlation of Fatigue and Overstress.

NATURE

SATURDAY, SEPTEMBER 7, 1929.

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Science and Industry.

LEMUEL GULLIVER, referring to the Brobdingnagians, remarked that "the learning of this people is very defective, consisting only in morality, history, poetry, and mathematics, wherein they must be allowed to excel. But the last of these is wholly applied to what may be useful in life, to the improvement of agriculture, and all mechanical arts; so that among us it would be little esteemed." Hence it is not surprising to learn that the king of that country "gave it for his opinion, that whoever could make two ears of corn, or two blades of grass grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country than the whole race of politicians put together".

The royal opinion was a little hard on the politicians, but it conveys an element of vital truth, for the power of science to exalt or destroy a nation is exceeded only by its power to sustain or wreck a generation. We have ourselves seen man employ it and compel its use in works of destruction, and we are realists enough to admit that only the complete suppression of war can justify neglect of the military potentialities of science. There is, however, now presented to us, and reiterated in convincing terms, an appeal for its more earnest application in the attainment of a greater measure of happiness, health, and wealth, and to that appeal we once again subscribe. The use of science in the service of industry (leading, incidentally, not to the last of these three aims only) and, conversely, the opportunity which industry enjoys of promoting the advance of pure science—an oscillatory motion of ever-increasing amplitude—formed the subject of a series of discussions at meetings of the British Association at Cape Town and Johannesburg, whereby an idea of the advantages already gained by such co-operation could be acquired.

Opening the discussion at Cape Town, Sir Thomas Holland said that science touches on problems of philosophy and often appears to trespass on the province of theology, whilst every branch has some influence on the progress of industry, but he admitted that one of the difficulties which is quickly encountered by those who attempt to present scientific results to the general public, and even to correlate scientific work in different directions, is that arising from rapidly developing specialisation, with its concomitant specialised terminology. Whilst this is perfectly true, we must remember that the difficulties of modern scientific

terminology do not, perhaps, appear so insuperable to the scientific worker as to the layman, for the former takes to a new, although possibly ungainly, word as naturally as a workman to a sharper tool, whilst the latter seldom troubles to understand terms not included in the vocabulary appropriate to his own interests. Once the interest is aroused, the difficulties tend to diminish, and the terminology, of radio communication for example, to become part of the common language. Nevertheless, the tool must not be brandished out of season, even though the alternative lacks convenience, whilst the layman should remember that the Balnibarbi method of abolishing words by substituting the things themselves merely laid greater physical burdens on the common people.

Sir Daniel Hall's subject, the development of agriculture and the anxiety which it is causing both to farmers and to statesmen, is fundamental in its importance. Food production all over the world is still being carried on by comparatively primitive methods and is mainly in the hands of small producing units, although it has been possible to give effect to some of the progress achieved by science whenever that is utilisable by the individual; the use of new varieties and the application of artificial fertilisers were quoted as examples. At the present day, comparatively little of the naturally rich and easily worked land is still unoccupied and, moreover, the peasant has observed that industry offers a livelihood in return for less continuous toil. Hence Sir Daniel Hall regards as inevitable some approach to the industrialisation of farming, citing as an example of such industrialisation and scientific control the development of sugar cane cultivation in Java, where in fifteen years the yield of sugar per hectare has been increased by one-half. The increased use of artificial nitrogenous fertilisers has had demonstrably favourable results and has demanded correspondingly increased employment of potash and phosphatic fertilisers; for these we must rely on natural deposits, and eventual recourse to means of conservation of these elements is envisaged.

Increased fertility of the soil is not, of course, the whole solution of the problem of feeding many more mouths than formerly. The plant breeder seeks to produce varieties of high utility, suitable for the enriched soil, resistant to disease, and economical of water, whilst the effective use of insecticides and fungicides, the preservation and transport of meat and fruits, and stock-raising offer wide fields for study.

Prof. A. C. Seward, who at Johannesburg illustrated his theme by reference to the Abbé Mendel's experiment in crossing peas, to the results of investigations on the storage of apples, the artificial ripening of oranges, and the refrigeration of meat, emphasised the importance of three factors: the specialist's investigations, the layman's intelligent and sympathetic interest, and the scientific popularisation of science; there is need for a wider recognition on the part of specialists of the importance of taking greater pains to make clear to the non-scientific worker and to the other specialist the nature of their researches. Yet another practical application of scientific study mentioned by Prof. Seward is the value of anthropological researches as a source of inspiration for administrators entrusted with the government and care of uncivilised peoples.

Sir Richard Gregory, speaking at Cape Town, showed in a metaphor which has attracted considerable attention that creative science, purposeful invention, and skilful labour are the three legs of the tripod upon which industrial development rests. There can be no stability unless each foot stands firmly upon the ground of common interest and each bears its share of the structure supported by the combination. Without this triple alliance of the scientific investigator, alert manufacturer, and skilled operative, no nation can expect to be in the van of modern progress. Sir Richard's examples of discoveries which revolutionised whole sections of industry included the foundation of electro-chemical processes by the work of Davy and Faraday at the Royal Institution; the evolution, from Sir Robert Hadfield's researches, of special alloys used in the construction of every motor car, aeroplane, projectile, tramway crossing, machine-tool, or other product of modern engineering; the life-belt which the late Auer von Welsbach threw to the gas industry in the form of his incandescent gas mantle; and, in recent years, the discovery of inert atmospheric gases and their application: argon for the manufacture of gas-filled electric lamps, neon for lamps adapted to the illumination of airways and to advertisement signs, and helium for the inflation of airships. The concluding words of this address will bear quotation and repetition: "The debt of industry and of modern civilisation to science is unmistakable; it can best be paid by creating and fostering facilities for further research, and from the argosies which will then in due course come into port, the human race may confidently expect to be provided with principles and powers even more potent for industry and social service than anything the world has yet seen."

The Hon. Henry Mond, after describing to a Johannesburg audience the origin of the Mond nickel carbonyl process, declared that patient research in those branches of science which are likely to be of assistance to industry will nearly always produce something. Yet although the general attitude of modern industry towards research is unexceptionable, industrial research is exposed to big dangers. There is a tremendous drift towards administration, which is always accentuated during a period in which an industry is expanding. The driving force behind any research department should be scientific enthusiasm, for it is only by enthusiastic, alert research workers that discoveries will be made. Again, success is often dependent on the development of a suitable technique, such, for example, as that which has been responsible for the growth of the great high-pressure industry of the manufacture of fertilisers by Imperial Chemical Industries, Ltd., at Billingham.

Dr. F. E. Smith devoted his address at Cape Town to one of the earliest industries in the world —the mercantile marine. Modern standards of safety and comfort have resulted from the labours of scientific men. Astronomers—Copernicus, Kepler, and Tycho Brahe—first taught the navigator to regard the starry universe as a great clock-dial, with the moon and planets as mighty hands moving through the heavens. The modern compass was developed by Lord Kelvin, who, in association with Sir George Airy, an astronomer, and Captain Flinders, a navigator, applied corrections for its use in iron ships, whilst the scientific work of Foucault led to the invention of the gyro-compass. Dr. Smith referred to the scientific worker's contributions in the form of echo-sounding, radio communication, the chronometer, and the sextant; he indicated advances in the science of ship construction, and the great progress that has been made in the use of motive power, mentioning, among others, the names Black, Carnot, Joule, Mayer, Regnault, James Watt, and Sir Charles Parsons. The day will come, he said, when the scientific worker has at his command excessively short wireless waves which can be transmitted from a ship and reflected from an iceberg, reception of the reflected waves rendering detection of the iceberg a certainty.

Prof. G. W. O. Howe told a Johannesburg audience that electrical engineering could be said just to have celebrated its golden jubilee, for although the science rests on Faraday's discoveries, in 1821 and 1831, respectively, that a wire carrying a current experiences a force tending to move it if it is situated in a magnetic field, and that an electric current is set up in a wire if it is moved in a magnetic field, it was in 1878 that Swan developed the first commercial incandescent lamp, and in 1879 that the electric locomotive was first demonstrated at an exhibition in Berlin. Now the electrical industry, a relatively new industry, born of scientific discovery and developed by patient scientific research in physical, chemical, metallurgical, and engineering laboratories, is an extremely large employer of labour.

Engineering science, said Prof. Howe, has contributed largely to the very rapid advance in the improvement of living conditions in the civilised world; it has even negatived Nature's ordination that man's movements should be limited to the surface of the earth. In no branch of human activity has scientific research worked greater wonders than in the transmission of intelligence; even the immense advances which have been achieved since about a hundred years ago, when messages were slowly transmitted over a few miles of wire, have been eclipsed in the popular imagination by the triumphs of the last few years in radio telegraphy and telephony. When the relation of science to industry is expressed as the relation of an ordered knowledge of the properties of the materials and processes employed in any manufacture to the successful and economic carrying out of the manufacture, little room is left either for doubt or discussion. The science pertaining to any industry is the very life blood of the industry, and every scientific discovery is an added asset to the human race.

It will be observed that the purpose of the discussions was not to reveal new or startling discoveries to a scientific coterie; its aim was to emphasise, and lend authority to, what has been said many times before, in the hope that individual citizens of our Commonwealth will take a serious and energetic view of their individual responsibility. The responsibilities are not merely national, or exclusively material; they do indeed closely concern our prosperity as an agricultural and an industrial Empire, but they also have a very intimate relation to the social conscience. The individual duty is that of contributing in due measure to the formation and expression of public opinion. Whether through the rise of popular government and the ubiquity of the printed and broadcast message, or through national stress and economic adversities, it is unquestionable that to-day well-educated and better-informed peoples have adopted a critical attitude, an attitude of intelligent examination of

the laws and circumstances at the helm of their lives. Their conclusions—public opinion—are not always resilient, not always quite accurate, but are in the main characterised by sound sense and humanity, and count for a great deal in places where they govern. Thus British public opinion to-day abhors drunkenness but preserves liberty, it condemns both sweated labour and selfish ease, it regards religious intolerance as a medieval anachronism; it has so far progressed as generally to approve advance along scientific lines, to offer encouragement to a scientific development of agriculture and industry, and to implement its approval by subsidising such advance and development in certain ways.

What is now much to be desired is a public which will plainly show itself to be as intolerant of inefficiency in method as it is of inefficiency in effort; which insists that its enterprises shall be conducted not only with faith and with courage, but also with open eyes, that its resources shall be conserved by the best methods known, and utilised to the best advantage attainable, that its man-power shall be employed as brain-power in preference to horse-power, and that ailments of the body politic shall be diagnosed and treated by specialists.

That the plea was made at Cape Town and Johannesburg by men of science themselves is significant, but in a sense fortuitous. They used no arguments, no illustrations, that have not been or could not be employed by captains of the ship of industry or of the ship of State, who have from time to time lent the weight of their experience and their authority to the same appeal, adding to it other and convincing examples of their profitable application of scientific work. Indeed science, like honesty, is indubitably the best policy.

The Bio-Psychology of the Cat.

The Modern Cat, her Mind and Manners: an Introduction to Comparative Psychology. By Prof. Georgina Stickland Gates. Pp. xii + 196 + 4 plates. (New York: The Macmillan Co., 1928.) 8*s*. 6*d*. net.

MANY books have been written about cats; but this is the first to approach doing justice to the subject, for it tries to tell the truth about cats, so far as the truth is known at present. It is not fanciful or romantic; it is a serious contribution to the bio-psychology of the domestic cat, and it is written critically and with humour. Yet Dr. Gates is far from being one of those philofelines who provoked Andrew Lang's wrath—"authors who speak concerning cats with a familiarity and a levity most distasteful".

In a scientific appreciation of an animal's ways, it is useful to begin with the senses; and in some respects the cat is well-endowed. Gautier tells a delightful story of Madame Théophile's encounter with a green parrot. "The cat, after spending some moments in silent contemplation of the bird, decided that what she saw was a green chicken, and reasoned further that even if green, the chicken should be good to eat. As she sprang at him, the parrot cried out suddenly, 'Have you had your breakfast?' The cat fell back; her thoughts were apparent: This is not a bird; it speaks; it is a gentleman." Miss Gates appreciates Gautier's story, but scientifically she is bound to puncture it, since all the experimental evidence points to the conclusion that the cat is colour-blind. It can distinguish different degrees of brightness, but it lives in a grey world. Its very marked power of expanding and contracting the pupil may be correlated with the nocturnal hunting, when it is important to make the most of the scanty rays. The tactility of the vibrissæ is also an aid to walking effectively in darkness. Not much has been proved in regard to the cat's sense of smell, but it is probably acute. As to hearing, cats are able to discriminate between differences in sound, and can learn in forty-five or fifty lessons to associate a particular vocal signal with a particular reaction. Yet there is no convincing evidence that they can distinguish differences in pitch. Their auditory world is like that of a tone-deaf individual.

Awaiting further investigation is the 'homing' exhibited by some cats, for experiments show that they can return from a place three miles off or so, to which they were carried under conditions excluding intimations from sight, hearing, and smell. They seem usually to take many hours to return, and this suggests that they have to make many tentatives. This probably holds for returns from long distances, for example, from Ayrshire to Fife, but no adequate experiments have been made with these 'orientations from a distance', if such they are.

Another well-known capacity, that of falling on their feet, has been more adequately studied. For it is known that a cat dropped from a height on a soft bed, goes through a series of righting reflex-movements, activated partly from the eyes, but essentially from the semicircular canals of the ears.

There is a luminous chapter on the cat's instinctive behaviour, though more might have been made of the difference between a simple inborn

activity like purring and a concatenation like maternal routine. A good instance of instinctive behaviour is seen when the kitten chases a small moving object, and this is normally the prelude to the specialised mouse-killing instinct. In regard to the latter, it seems certain that it is likely to remain in abeyance if it is not activated before the third month. The trigger-pulling normally occurs when the kitten is about two months old, and it is a remarkable awakening. All of a sudden the playful and irresponsible kitten becomes transformed into a beast of prey very much in earnest. "The hair bristles, the tail is erected or switched, there occurs hissing, sometimes spitting, growling, unsheathing and sheathing of the claws. Even in the first kill the kitten seizes the mouse by the head, neck, or back, in such a way that it cannot bite." If the liberating stimulus is too long deferred, the relatively mis-educated kitten may grow up more or less indifferent to mice. Cat and mouse friendships have often been recorded, in newspapers at least.

Generous philofelines mix up sensory acuteness, inborn reflexes, and instinctive endowments with genuine intelligence; and the result is a very wonderful and equally unreal cat. Similarly, they put the results of training down to the credit of cleverness. When Stables held his cat opposite a big map of London with the chief buildings marked by dark splashes, it used to put its paw on the British Museum or the like when the name of the sight was shouted out. This was very disconcerting to the onlooker, but it turned out that the cat was accustomed to catch flies on the wall, and mistook the dark splashes on the map for its accustomed booty!

Cats can be trained to open boxes, to escape from latched cages, to use their paw in getting cream out of a narrow-necked jug, to press a button, to pull a loop, to ring a bell, and so on; and the usual method is to go through the process patiently and repeatedly, and to reward success generously. In other cases, the conditioned reflex method is used: a real stimulus induces a natural response, but along with the real stimulus there is simultaneously associated an arbitrary signal, such as a command; by and by the secondary stimulus works without the first. Thus the cat 'begs' when you tell it, and food may be dispensed with.

Having skilfully disposed of the non-intelligent modes of feline behaviour, Dr. Gates is able with a clear intellectual conscience to discuss the higher levels of the cat's mind. From the experimental data adduced "it seems extremely probable that the cat experiences the general bodily states of pleasure and pain, and those major emotions of fear, anger, general excitement, in a manner comparable though not identical with ours". On the ideational side, the cat does not seem to be highly evolved, for although it may sometimes show an intelligent appreciation of a critical situation, and put two and two together, controlling new action in the light of previous experience, it has probably a very poor repertory of ideas, very little memory, and still less anticipation. We should be inclined to be rather more generous than the author, but her critical parsimoniousness is most refreshing. We recommend the book with enthusiasm; it is a masterpiece of its kind and very good reading. It will in the end delight even those who are sure that their beloved puss "understands every word they say".

Sound, Speech, and Hearing.

(1) *Handbuch der Physik.* Herausgegeben von H. Geiger und Karl Scheel. Band 8: *Akustik.* Redigiert von F. Trendelenburg. Pp. x+712. (Berlin: Julius Springer, 1927.) 58·50 gold marks.

(2) *Speech and Hearing.* By Dr. Harvey Fletcher. Pp. xv+331. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1929.) 21*s.* net.

WITHIN the last two or three years the whole of acoustics has been surveyed in several important books. Richardson's "Sound" has covered the experimental field, Crandall's "Vibrating Systems and Sound" may well be regarded as a third volume of Rayleigh's classical work, whilst the more specialised volume, Davis and Kaye's "Acoustics of Buildings", deals with a subject of great practical importance which has been neglected even in its applications to the lecture theatres of the physical departments of some of our universities.

(1) The first of the present two volumes, a collective work of 700 pages by eleven authors, is naturally very comprehensive and is, like the Auerbach volume in Winkelmann's "Handbuch der Physik", an indispensable work of reference. For this reason, at the outset, protest must be made against its publication without an author index. Whilst each of the sixteen sections is admirable in itself, there appears to have been little attempt at co-operation between the authors. The result is a good deal of needless repetition. In those subjects of which the reviewer has research knowledge the treatment is very complete but is

quite uncritical, references being given to work which other researches mentioned show to be unsound. The volume does not, therefore, itself always give directly the present state of knowledge in any particular subject. Such a critical treatment could easily be obtained by very considerably increasing the number of co-operating authors if some means of overcoming the difficulties involved in wide co-operation could be found. Then, through the medium of a 'Handbuch', a research worker could readily get the actual state of knowledge in any subject.

It is surely a mistake to have a separate section on the acoustics of musical instruments. The mechanism of these is too complex to be treated analytically, and to study their complex sounds experimentally by getting reliable records is a task of extraordinary difficulty. With the possible exception of the elaborate electrical outfit of the type used in the Bell Telephone Laboratories, New York, there is no sound-recording apparatus capable of giving quantitative data, and, moreover, there is no standard source of sound by which distorting sound-recorders can be calibrated. For these reasons little is known of the acoustics of actual musical instruments, and it is almost unavoidable that the 70-page section dealing with the subject considerably overlaps Prof. Kalähne's admirable section on mechanical sound generators.

The space saved by avoiding repetition could be well occupied by a comprehensive bibliography of books on acoustics to replace the meagre list (p. 4) of eight classical works.

(2) The telephone 'wrong number' problem is ever with us, either in reality or through the pen of the humorist. Dr. Fletcher's fascinating volume originated in researches upon the fundamental problems arising out of it. Fifteen years ago the Bell Telephone Laboratories of New York set out upon a systematic investigation of the whole telephone system, including both speaker and hearer. They wisely took advantage of the immense resources at their disposal and planned a research so comprehensive that it is still in progress, parts of it being little more than started. The aim was "to get an accurate physical description and a measure of the mechanical operation of human ears in such terms that we may relate them directly to our electrical and acoustical instruments; to test the keenness of the sound-discriminating sense and find what is the smallest distortion which the mind can perceive and how it reacts to somewhat larger distortions".

The solution here given of the extremely difficult problem of obtaining a reliable record of a complex sound, is by the use of an electrical apparatus (*Bell System Tech. Jour.*, **4**, pp. 586-626; 1925) consisting of condenser microphone, amplifier, and a special oscillograph, all of which have been carefully standardised and calibrated. The record obtained is a photographic oscillogram, and many examples are reproduced and discussed in the book.

The three main sections are devoted respectively to speech, to hearing, and to the perception of speech and music. Numerous interesting results, most of which have been obtained in the Bell Telephone Laboratories, are presented very attractively with ample illustration and quantitative data in the form of graphs. The text is almost free from mathematical argument, so that it can readily be followed by the general reader. This is important on account of the wide appeal of a subject which is fundamentally that of the most rapid means of communication of thought between human beings. The danger of placing too much reliance upon the evidence of our ears is clear from such results as are described in the chapters on minimum perceptible differences in sound and on the masking of one tone on another. There is a good deal of information on 'noise' in general. One curious result is that apparently the interference to a person carrying on a telephone conversation in a noisy room is due mainly to the room sounds getting into that ear which is pressed on to the receiver. The index is not quite so good as it might be, for data given in the chapter on physical properties of musical sounds, and not published elsewhere, are not to be found from the index under the names of the various musical instruments.

Throughout the volume there is abundant evidence of the immense importance in modern acoustics of the thermionic valve and electrical apparatus generally. The research worker will be delighted to note as he reads the many examples of elegant research technique, including the skilful use of physiological and psychological evidence when a purely physical treatment of a problem failed. It is very pleasant to realise that the actual result of the work of one of the largest industrial research organisations in the world is facilitation of the rapid interchange of thought between human beings no matter how widely they may be separated. This is a subtle and powerful factor in the removal of international misunderstandings. Our thanks are due to the workers of the Bell Telephone Laboratories for adding so much to knowledge, and to Dr. Fletcher for giving so excellent an account of the work.

W. H. GEORGE.

Elementary Physical Chemistry.

A Class Book of Physical Chemistry. By Prof. T. Martin Lowry and Dr. Samuel Sugden. Pp. vii + 436. (London: Macmillan and Co., Ltd., 1929.) 6*s*. 6*d*.

THIS book gives a clear and straightforward account of the principal parts of elementary physical chemistry. It contains instructions for carrying out illustrative experiments, and is provided with questions at the ends of the chapters.

In the preface the authors state that, since "the normal scope of an elementary course of physical chemistry is already well defined", they have "in the main been content to keep within it, without trying to exploit unduly the more novel or personal points of view". This is doubtless a prudent attitude, but it naturally limits the interest of the book as a contribution to the solution of that fascinating but difficult problem now confronting all teachers of physical chemistry, namely, how to present to their pupils the results of the last ten years of investigation. Modern work, both theoretical and experimental, has completely changed the aspect of many parts of physical chemistry, co-ordinating much that was fragmentary, and illuminating much that was obscure, but unfortunately a good deal of it is mathematically considerably more complex and difficult than that which it has superseded. An elementary treatise which is wholly modern in outlook will be something of a pioneering work. The nearest approach to it which we yet have in English is perhaps H. S. Taylor's shorter book, "Elementary Physical Chemistry".

In relation, however, to its stated object, the book under review is quite a good one. It deals first with the three states of matter and the phenomenon of liquefaction, then discusses in turn the phase rule, osmotic pressure and the determination of molecular weights, and proceeds to thermochemistry, chemical equilibrium, velocity of chemical change, and the mechanism of chemical change. Two chapters on electrochemistry follow, and finally one on colloids and one on adsorption. Thermodynamic proofs are given shortly in connexion with the matters to which they are relevant. One naturally looks for some account of the parachor, and is not disappointed, a few pages being devoted to a brief but clear summary of the principal results.

On p. 306 the dictum that "chemical action is reversed electrolysis" is endorsed, but the reviewer is still unable after reading this particular section of the book to attribute any more meaning than before to this well-known phrase. The statement on the preceding page that "pure water formed from highly purified hydrogen and oxygen will not initiate an explosive combination of these gases", though quoted by nearly all books, is meaningless. If the pure water is formed, the gases have evidently combined, and whether or not the combination is explosive is purely and simply a question of the relative rates of the production of heat and of its removal by conduction.

The proof of Avogadro's law from the kinetic theory, given in Chapter i., is misleading. It is not obvious without elaborate and difficult proof that the average kinetic energy of the individual molecules is the same for each gas: therefore the impression should not be conveyed that it is self-evident. The ordinary elementary discussion involves something very like an argument in a circle.

It must not be supposed that the two points here dealt with are in any way characteristic of the book as a whole. Most of it is clearly and accurately written, and it is likely to be thoroughly useful to certain kinds of student.

Classical Electrodynamic Theory.

Lehrbuch der Elektrodynamik. Von Prof. Dr. J. Frenkel. Band 2: *Makroskopische Elektrodynamik der materiellen Körper.* Pp. xii + 505. (Berlin: Julius Springer, 1928.) 45 gold marks.

THE second volume of Frenkel's "Elektrodynamik" extends the microscopic theory—the individual electron theory—to the form of the theory, obtained by statistical averaging, which is concerned more with the behaviour of matter in bulk, that is, with electromagnetic phenomena as they are presented to our senses. The work is divided into two main sections, the first of which contains a derivation of the form of the equations of the theory applicable to fields containing distributions of matter of various types; here we find a detailed exposition of such subjects as dielectric and magnetic polarisation, of electrical conductivity, and of the energy and mechanical relations of the bodies in the field.

The second section of the work starts with a discussion of the propagation of electromagnetic waves in material media—of both limited and unlimited extent. This is followed by a treatment of the so-called quasi-stationary phenomena, including the usual problems of electromagnetic induction. Finally, there are brief chapters on electrostatics, magnetostatics, and electrokinetics, and an

appendix containing the detailed analysis of many of the formulæ quoted in the general text.

Although the treatment of the subject is essentially mathematical, the actual formal analytical work is not allowed to hide the predominant physical character of the theories discussed. In the later sections, for example, the individual problems are worked out quite generally, but only in sufficient detail to bring out the physical significance of the results derived from them. The result is that the work provides very stimulating reading, whilst in comprehensiveness it would be difficult to improve upon in such a limited number of pages.

To the present reviewer this work is specially interesting, in that it shows a definite break in the continental school of thought from the Helmholtz-Lorentz ideas on this subject, consummated in the various appropriate articles in the "Encyklopädie der mathematischen Wissenschaften" (Bd. 5). Thirty-five years ago Larmor pointed out certain errors and inconsistencies in this form of the theory and drafted the outlines of a modification, but his remarks remained unheeded, and the theory has held almost universal sway. At long last, however, it seems that someone else is realising that the usual conceptions of magnetic force and induction are really in the reverse order to what they ought to be, that the expressions given in all the usual treatises for the stresses in a polarised medium are not those derived in a really consistent theory, and that certain apparent discrepancies of sign which occur in discussions of magnetic energy are not discrepancies at all and do not need explaining away.

Dr. Frenkel's book is not completely satisfactory on these points, but at least it is sufficiently different from the older accounts to make the reader hesitate and wonder why; and if he does, he will have little difficulty in filling in the lacunæ himself. For this and many other reasons the work can be strongly commended to all those who are still interested in classical electrodynamic theory in its modern form. G. H. L.

Our Bookshelf.

Vergleichende Anatomie des Nervensystems der wirbellosen Tiere: unter Berücksichtigung seiner Funktion. Von Dr. Bertil Hanström. Pp. xi + 628. (Berlin: Julius Springer, 1928.) 76 gold marks.

THE introductory general part of the work contains accounts of the phylogeny of the nervous elements, of the inter-relations of the various types of cells—sensory, intermediary or associative, and motor—and of the cytology and histology of the nervous tissues of invertebrates, and a discussion of the neurone theory. The author states that his observations on the eyes and optic ganglia of arthropods afford no evidence of the continuity of neurones. In the special part each phylum is considered in turn, beginning with the Protozoa.

Although the nature of the neuromotor system of ciliates is as yet not definitely determined, the author is inclined to the view that it is a conducting system. Turning to cœlenterates, he gives a careful account of the nervous elements, our knowledge of which is admittedly not satisfactory. The observations of Bozler on the bipolar and multipolar cells of the ectodermal nerve plexus of *Rhizostoma* are cited as clear evidence that—in spite of the frequent reference by many authors to the existence of a nerve net in cœlenterates—the connexion between one neurone and another in this case is not by continuity but by contact (contiguity) of the fine terminal branches. For each of the other groups of invertebrates a summary is given, first of the general anatomy of the nervous system of selected examples, and then of the histology and, so far as it is known, of the topography of the neurones, concluding with a general survey of the structure, and a discussion of the function of the nervous system of the group with adequate references to the more important memoirs. Useful comparisons are made between different types of nervous system, for example, of Turbellaria and Annelida, of Arthropoda and other segmented invertebrates, and of the brain of insects, myriapods and Crustacea. An index of subjects and another of the genera and groups are appended.

The work is excellently produced and the author has spent great pains on the illustrations. Most of these have been carefully selected from published memoirs, but more than a hundred are new—chiefly photomicrographs of the author's preparations. Such a volume could have been written only by one who is familiar with the scattered literature of the subject and brings to its analysis the specialised knowledge of an investigator in the same domain. The author is to be congratulated on his adequate treatment of a difficult subject.

Oddities: a Book of Unexplained Facts. By Lieut.-Comdr. Rupert T. Gould. Pp. 336 + 8 plates. (London: Philip Allan and Co., Ltd., 1928.) 12*s.* 6*d.* net.

THE inexplicable is always fascinating, and here is both a humorous and a serious study of such oddities. The zoologist can speculate as to the 'Devil' who came out of the sea and impressed his 'Hoof-Marks' on the Devon coast. Crosse's Acari, produced by long-continued electrical action, go far beyond the bacteria and slimes produced by professional spontaneous generationists. The demons or ghosts which come from unknown realms to interfere with coffins and their contents, as at Barbados, certainly merit the attention of a 'learned' society and of some 'scientists'. The possibility of the reincarnation of such people as the Berbalangs of the Philippines is believed by all wild peoples. The Wizard of Mauritius of the eighteenth century, who could foretell the arrival

of ships several days beforehand, will be claimed by some ethnologists to have his prototypes in many a savage isle of the Pacific. The search for the Auroras and other lost islands still goes on, and this story of several southern isles is from an expert. All Britain was excited over the fate of Franklin in 1845–46, and were "The ships seen on the Ice" of a great berg near Newfoundland in 1851 the *Erebus* and *Terror* with which they so clearly corresponded? We suppose the astronomers will not allow us the planet Vulcan, but popular writers still regard it as a subject for speculation. Our editor and the president of the Royal Society are the two targets for the fiends of 'perpetual motion', but really it is rather difficult for the layman to understand that the hypothesis of the conservation of energy holds for space as we know it. Orffyreus was mad perchance, but we, like our author, would not accuse him of being a knave. Astrology in the person of Nostradamus comes in too—and we may refer our readers to the professor of this 'science' in Oxford, our sole specialist in this modern age. Buy and read this book; every page interests, and no page bores. J. S. G.

Proceedings of the Seventh International Congress of Photography, London, July 9–14, 1928. Editors: W. Clark, T. Slater Price, and B. V. Storr. Pp. xiii + 571 + 29 plates. (Cambridge: W. Heffer and Sons, Ltd., 1929.) 25*s*. net.

THE report of the proceedings of the Seventh International Congress of Photography, which was held last year, is now ready. It is noteworthy that the whole is in English, although some of the papers and speeches were originally in other languages. It contains an account of the opening and closing meetings, resolutions and recommendations, the introductory lecture by Mr. F. C. Tilney, "On the Relation of Technical Advance to further Artistic Achievement", the papers read at the various sections and the discussions on them, and as appendices, various lists of members, officers, and committees. The sections comprise the theory, practice, and scientific applications of photography, photo-engraving, colour photography, kinematography, bibliography, record photography, etc. It was unanimously agreed that the next Congress shall be held in 1931 in Dresden, an interval of three years instead of seven, which, however, is fully justified by the large number of chemists and physicists who are now at work on the subject. The volume is a very valuable addition to the literature of photography.

Institut International de Physique Solvay. *Électrons et photons: rapports et discussions du cinquième Conseil de Physique tenu à Bruxelles du 24 au 29 octobre 1927 sous les auspices de l'Institut International de Physique Solvay.* Pp. viii + 290. (Paris: Gauthier-Villars et Cie, 1928.) 60 francs.

FOUR of the six articles in this volume are concerned with the new quantum theory, L. de Broglie, M. Born and W. Heisenberg, E. Schrödinger, and N. Bohr contributing accounts of the special points of view with which they have become associated. The remaining papers are upon the intensity of reflection of X-rays (W. L. Bragg) and the discrepancies that exist between the electromagnetic theory of radiation and experiment (A. H. Compton). As in previous reports of the meetings of the Solvay Institute, each article is followed by an account of the ensuing discussion, the concluding one, on the general aspects of the new theories, being particularly interesting.

Lorentz's views on the new mechanics are stated fairly definitely in the last discussion. For him an electron was "un corpuscle qui, à un instant donné, se trouve en un point déterminé de l'espace"; he wished to "décrire tout ce qui se passe dans le monde par des images nettes"; and finally, "Faut-il nécessairement ériger l'indéterminisme en principe?"

This report is a useful record of the state of fundamental physical theory at the time when the conference was held, and as such is likely to become a valuable historical document.

Plant Life and its Romance. By Prof. F. E. Weiss. Pp. viii + 136. (London: Longmans, Green and Co., Ltd., 1928.) 5*s*. net.

IN "Plant Life and its Romance" Prof. Weiss reproduces twelve broadcast talks to school children. Of these, the first eight treat in succession of the various plant groups as presented by the life-histories of typical members. Beginning with *Euglena* and *Chlamydomonas*, the seaweeds, fungi, bacteria, liverworts and mosses, ferns, clubmosses and horse-tails, conifers, and flowering plants are each dealt with in turn. For the general reader the greatest interest will probably be found in the last three chapters, which respectively concern themselves with evolution, with the distribution of plants, and with the history of the British flora. It is interesting to note that in treating of distribution the author clearly favours Wegener's hypothesis, although it is perhaps from the biological point of view that this hypothesis is least acceptable.

The style, as befitted the occasions, is simple, but the author's hope that the reader's appetite may be whetted for further study would be more likely of fulfilment had a less academic point of view been adopted in the earlier chapters.

Alfalfa. By J. F. Cox and C. R. Magee. (Wiley Farm Series.) Pp. xi + 101. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 7*s*. 6*d*. net.

THIS handbook on the growing of lucerne in the United States of America is intended for the practical farmer. The authors discuss the merits of different varieties and strains and the need that exists for securing the right strain of seed to suit local climatic conditions. There follows a description of the methods of growing, harvesting, curing, and utilising the crop and of how to grow lucerne for seed. The place which lucerne takes in the rotation under different methods of farming is also dealt with and there is a short description of the major pests and diseases which affect the crop.

The book is thoroughly practical and is well illustrated.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

X-Ray Diffraction by Plane Gratings.

RECENTLY Bäcklin (*Inaug-Diss. Uppsala Universitets Årsskrift*, 1928) and Bearden (*Proc. U.S. Nat. Ac. Sci.*, **15**, 528; 1929) have made precision measurements on X-ray diffraction by plane gratings. Both investigators deduce from these experiments values for the wave-length which are slightly higher than those calculated from crystal reflection measurements. As the latter values depend on Avogadro's number, they conclude that the accepted value of this constant is slightly in error. Part of the discrepancy, however, may be due to another cause; Bearden and probably Bäcklin do not seem to have taken account of the fact that the usual diffraction formula needs a correction (Porter, *Phil. Mag.*, **5**, 106; 1928) when applied to X-rays under the usual experimental conditions. In the case of Bearden's results, I find that for the first order spectrum this correction amounts to about half the difference in question. As the exact data of Bäcklin are not now at my disposal, I cannot judge how far the same remark applies to these.

The correction arises from the fact that a *divergent* beam is broadened *asymmetrically* by diffraction at a *plane* grating. Different methods may be suggested to eliminate this effect. Probably the most simple device would be to put the first slit (as well as the plate) at a great distance from the grating. The alternative method of using very narrow slits seems less appropriate, as then the number of diffracting elements becomes too small. A third method, theoretically perhaps the best one, would be to use a cylindrical grating (radius of curvature about 20 m.). I have tried to bend a plane grating to this shape, but have not succeeded in getting a sufficiently regular surface in this manner.

I also wish to comment on the intensity of grating spectra. Recently I have made some experiments on this point, using an X-ray grating spectrograph designed by Prof. Coster and myself. In these experiments an X-ray beam (wave-length 1-40 A.) falls on a plane grating ruled on glass with a grating constant of 20 μ. The glancing angle of incidence is varied; when it is not too small, every spectral line gives rise to some spectra between the zero order and the direct ray ('negative orders') and several spectra at the other side of the zero order ('positive orders'). Now when the glancing angle is increased so as to approach the 'critical angle of total reflection' for a certain spectral line, then the positive orders (in the first place, the higher orders) of this line become very faint, as is to be expected. But at the same time the negative orders remain fairly strong, even when the glancing angle is increased so as to be appreciably greater than the critical angle. They disappear gradually when the angle is still further increased. The same effect is visible in the continuous spectrum.

To explain these facts, we must keep in mind the well-known property that the distribution of intensity over the different orders depends only on the scattering power of one grating element as a function of the scattering angle. Thus the observed facts show that this scattering power is considerable even when the glancing angle of the incident beam is greater than the critical angle, but that in this case the scattered beam is restricted to smaller reflection angles in such a manner that, roughly, the deviation is not greater than twice the critical angle. Evidently this scattering is not adequately described by the term 'total reflection at the surface of the element'. The term 'refraction' would be more appropriate, but, strictly speaking, neither of these terms can be used; the correct treatment would consist in the rigorous solution of the involved boundary problem of wave theory, including the influence of absorption.

It may be mentioned that sometimes the use of the negative spectra is to be preferred to that of the positive spectra, as the dispersion is much higher and even becomes infinite half-way between the zero order and the direct ray.

On the other hand, the fact that the different spectral orders do not disappear simultaneously throws a new light on an investigation of Thibaud (*Compt. rend.*, **187**, 219; 1928), who has tried to determine the critical angle of total reflection for soft X-rays by observing the angle of incidence at which the spectra disappear. He assumes that this 'critical angle of incidence' is the same as the ordinary 'critical angle of total reflection' for the wave-length in question, but finds values which are much smaller than the theoretical ones. Now this is just what we should expect: according to the present theory, the critical angle of total reflection would be nearer to half the angle between the direction of the incident beam and the spectrum that is disappearing.

J. A. PRINS.

Natuurkundig Laboratorium
der Rijks-Universiteit,
Groningen.

Habitats and Feeding Habits of *Ocinebra erinacea*.

IT is well known that the rough-tingle, *Ocinebra erinacea* (= *Murex*), preys on oysters by eating them through a hole bored in the shell, and that it is also found abundantly in localities where oysters do not occur (Jeffreys, "British Conchology", **4**, p. 308). The food of this tingle must therefore vary in different localities. In 1927 I began experiments with the object of finding out whether *Ocinebra*, taken from a locality where oysters do not occur, or occur extremely rarely, for example, the shores of Plymouth Sound, would recognise and eat oysters. In this preliminary experiment I found to my surprise that *Ocinebra* from Plymouth Sound did not eat oysters, but forms which are recognised as the same species from the Fal Estuary (where oysters do occur) ate both West Mersea oysters and Plymouth barnacles readily. In July and October 1928 I began a fresh experiment and added small West Mersea (River Blackwater) oysters to each of the following dishes containing:

A. Plymouth *Ocinebra*, which do not grow to a large size, but the largest obtainable were collected and used, namely, up to, but rarely, 3·6 cm. long.

B. Falmouth *Ocinebra*, which attain a large size, and large ones were used, up to 4·6 cm. long.

C. West Mersea *Ocinebra*, which also attain a large size, 4-4·5 cm. long, but in this dish only small (and young) individuals were used, up to 2·6 cm. long.

During the first few months of the experiment and the ensuing cold winter, the *Ocinebra* were lethargic and ate little, except for the Plymouth stock, which were observed—from the character of the fæces—to be feeding mainly on the debris in the dish. In April and May they became more active and spawn was laid in all dishes except that occupied

by the small West Mersea stock. Larger individuals of the latter stock, however, spawned in a tank alongside. On July 26, 1929, the dishes were examined with the following result :

Dish.	*Ocinebra*.		Living Oysters.		Dead Oysters.		Total Oysters.	
	Living.	Dead.	Bored.	Not Bored.	Bored.	Not Bored.	Bored.	Not Bored.
Plymouth *A* .	193	71	4	18	6	54	10	72
Falmouth *B* .	57	93	16	39	18	30	34	69
West Mersea *C* .	21	9	1	3	45	10	46	13

The high mortality of non-bored oysters in the Plymouth dish, due no doubt to the deliberate overcrowding with *Ocinebra*, vitiates the experiment somewhat, but the general result is clear. The West Mersea *Ocinebra*, it is seen, fed largely on oysters ; those from the Fal ate some oysters, but appeared also to feed on the tubicolous worms growing on the shells of their fellows, and may also have taken detritus ; while those from Plymouth ate very few oysters, and obtained their food either from detritus or *Spirorbis*, which was growing plentifully on the shells of their neighbours. There were no barnacles in any of the dishes in this experiment. The Plymouth tingle were in better physiological condition than either of the other batches when first placed in the experimental dish, having been transferred in a few hours from the sea. On Jan. 16 three Fal *Ocinebra* were found to have crawled into the Plymouth dish and were removed, but it is unlikely that they had already eaten six oysters.

It is reasonable to infer from the experiment that a small percentage of the Plymouth *Ocinebra* discovered the value of the oysters and learned how to eat them. The fact, however, that 264 Plymouth *Ocinebra* attacked only 10 oysters, while 30 smaller West Mersea individuals actually ate 45 oysters, is a striking illustration of the difference in habit in the different localities, and shows, moreover, that the difference is not—as was first surmised—due to a different mode of feeding in the smaller and younger animals. There can be little doubt that *Ocinebra* from the three localities all belong to the facies generally recognised as the species *erinacea*, and that habit is a product of the habitat in this as in many other species, not excluding man. It is hoped in future to investigate to what extent the Plymouth and other stocks can develop a taste for oysters, and in so doing to acquire information regarding that correlation between physiological and morphological variation within the species which is so much desired.

J. H. ORTON.

Marine Biological Laboratory,
The Hoe, Plymouth,
Aug. 2.

Motion of an Electric Arc in a Magnetic Field under Low Gas Pressure.

IN the *Journal de Physique et le Radium* for April 1928, Prof. N. Minorsky describes observations he has made on the behaviour of a mercury arc in a magnetic field under low gas pressure. Under certain experimental conditions he found that the arc moved in a direction opposite to that which should be expected from the electrodynamical laws governing the movement of a conductor carrying current in a magnetic field, and proposes a space charge theory to explain this phenomenon. His theory is based upon the assumption that by the combined effects of collisions and the magnetic field, the electrons in the arc-stream are made to travel in the electrodynamic sense around the annular space in which his arc is drawn, and will thereby establish a negative space charge on the opposite side of the arc. The action of this space charge on the positive ions of the arc is assumed to cause the arc to move in the direction observed. It will be realised that this theory requires a circular or at least a closed path for the arc to move along.

Prof. Minorsky's article is the only reference to this phenomenon that I have been able to find in the literature. Without any knowledge of Prof. Minorsky's work in this field, I was greatly surprised to find, during some recent experiments with arcs under reduced air pressure, that the direction of travel of the arc was opposite to that which would ordinarily be expected from electrodynamic considerations. In my experiments the arc was drawn between straight metal contacts arranged as 'arcing horns'.

The contacts together with the necessary operating levers, etc., were located inside a glass desiccator, which during the experiments was evacuated to a pressure ranging between 30×10^{-3} mm. and 40×10^{-3} mm. of mercury. The arm supporting the movable contact was carried through the desiccator wall in a flexible bellows which permitted the separation of the contracts without interfering with the vacuum. The arc was formed by moving the contacts together, so that metallic contact was obtained, and then separating the contacts, drawing an arc between them. The arc was supplied with current from a 110 volt direct current source, the current being limited to about 10 amp. by an adjustable resistance. The only magnetic field present was that set up by the arc current itself when flowing through the contacts.

Under atmospheric pressure, it is well established that such a magnetic field would move the arc in a direction away from the points where the current is fed into the contacts. Under the pressures used during my experiments, the arc was found to move, however, in the opposite direction with velocities of several hundred centimetres per second. If electrodes of different metals were used, the anode was always found to be covered by a layer of the cathode metal, evidently transferred during the arcing. This was found to be the case even when the anode was made of a metal of much lower melting point than the cathode (for example, copper anode and tungsten cathode). After such experiments the cathode was evenly pitted to an extent easily noticeable with the naked eye, while the anode showed only faint traces of the arc even under a microscope, and then only when it had been carefully polished previously to the arcing.

The theory proposed by Prof. Minorsky is not able to explain the reversed direction of travel of an arc under the experimental conditions just described (where the arc does not move in a recurrent path). The experiments outlined above, the complete account of which will be published later, indicate that there is a considerable emission of metal vapour from the cathode. If this vapour is highly ionised, the positive ions moving with the vapour away from the cathode constitute a component of current opposite in direction to that of the resultant or total current in the arc. These positive ions moving with the vapour stream are thus deflected by the magnetic field in the opposite direction to that in which positive ions moving normally towards the cathode would be deflected.

After having travelled a short way from the cathode in the vapour jet, the positive ions are stopped and pulled back to the cathode by the impressed electric field. Although most of these positive ions probably disappear by recombinations, many of them will strike the cathode at a point shifted from the cathode spot from which they issued. The impingement on or at least the close approach of large numbers of positive ions to the cathode surface is very probably a necessary and sufficient condition for the formation of a cathode spot. We may therefore expect that these positive ions in the emitted vapour shifted in the magnetic field will cause a new cathode spot to develop, which ultimately will take over all the current from the previous cathode spot, causing the arc to move in a more or less discontinuous way in the direction opposite to that which would be expected from elementary electrodynamic considerations. R. TANBERG.

Research Laboratory,
Westinghouse Elec. & Mfg. Co.,
East Pittsburgh, Pa., Aug. 1.

Appearance of Noble Gases in Vacuum Tube Discharges.

THE views expressed in the article by A. C. E. in NATURE of June 8, p. 879, on the appearance of helium in apparatus employed in attempts at atomic synthesis and disintegration are in good accord with results obtained at the Physical Laboratories of the University of Chicago and of Hiram College. A repetition of the work of R. W. Riding and E. C. C. Baly, reported in *Proc. Roy. Soc.*, Series A, vol. 109, No. A 749, p. 186, has been undertaken by me under the direction of Prof. H. B. Lemon of the University of Chicago. The results have been inconclusive on the whole, but in all cases except one, helium has appeared in the observation tubes. The one exception occurred at the end of a very brief run in which insufficient time may have elapsed for diffusion to have provided enough helium to observe.

Our interest was aroused and has since been maintained, in spite of the appearance of much more complete tables of packing effects by Aston showing the unlikelihood of such results from energy considerations, by the statement of Riding and Baly to the effect that in the presence of a magnesium nitride film on their electrodes, helium was always obtained and neon generally, whereas these gases were never observed under conditions identical except for the absence of the film of nitride. No explanation of this particular phenomenon has been presented in the numerous criticisms which have appeared to date.

It seemed important, therefore, to attempt a repetition of the experiment. The procedure of Riding and Baly has been followed, introducing such alterations in the design of the apparatus as to make two identical bombarding and observation chambers differing only in the presence of a nitride film on the electrodes of one. Pyrex glass was used throughout, thus permitting a temperature of 450° C. during the out-gassing process. Mercury diffusion pumps were employed to evacuate the apparatus, and diffusion pumps were substituted for the Sprengel pump used by Riding and Baly to transfer the supposed products of disintegration from one point to another. A high-frequency electrodeless discharge was used to excite the residual gases in the observation tubes instead of the discharge between electrodes as was the case in the earlier experiments.

Each experiment was preceded by a thorough evacuation and simultaneous out-gassing at 450° C. extending from 24 to 48 hours, but the system was not washed out with hydrogen—which Paneth has found to be so essential. The apparatus was then allowed to stand for several days for minute leaks to be made evident. When no helium was found at the expiration of this period, the discharge was begun and continued for upwards of 100 hours at intermittent intervals. This part of the experiment extended usually for two weeks. In no case was any evidence found for the production of the noble gases from the nitride film, and it is our conviction that, as Paneth and others maintain, the appearance of such gases, helium particularly, is due to their diffusion in minute quantities from the atmosphere.

DONALD DOOLEY.

Colton Laboratory,
Hiram College, Ohio, July 15.

Raman Spectrum and Fluorescence of Benzol.

RECENT work on the Raman effect has indicated that the frequencies so determined may be attributed to vibrational frequencies, or combinations of such frequencies, of the normal electronic state of the molecule. It is therefore to be expected that these levels will appear as end states in the process of emission or fluorescence. This is neatly confirmed in the case of benzol.

Data on the fluorescence of benzol vapour is available from the work of Reimann (*Ann. d. Phys.*, **80**, 43; 1926) and Marsh (*J. Chem. Soc.*, **123**, 3319; 1923); although neither set of data can claim a high degree of accuracy, there is a satisfactory agreement between the two. It has now been found that all of the 51 bands given by Reimann can be arranged in series according to the general equation:

$$\nu = \nu_0 + n'a - n''_1 b_1 - n''_2 b_2 - n''_3 b_3 - n''_4 b_4,$$

where n' and the n'''s are the vibrational quantum numbers of the excited and normal states respectively, and a, b_1, b_2, b_3, and b_4 are the corresponding frequencies. The value of a is taken from the work of Henri on the absorption spectrum of benzol (see his "Structure des Molecules" (1925), p. 110) and is equal to 921 cm.$^{-1}$. The b levels, together with the corresponding Raman values in parentheses as averaged from recent literature, are:

$$b_1 = 998(991), \quad b_2 = 600(605), \quad b_3 = 855(853), \quad b_4 = 1180(1176).$$

Finally, $\nu_0 = 37494$ is given by Henri as the first member of an n' progression in absorption.

The following equations represent all of Reimann's data:

(1) $\nu = 37494 + n'(921) - n''_1(998)$
$n' = 0, 1, 2, 3$; $n''_1 = 0, 1, 2, 3, 4, 5, 6, 7$.

(2) $\nu = 37494 + n'(921) - n''_1(998) - n''_2(600)$
$n' = 0, 1, 2$; $n''_1 = 0, 1, 2, 3, 4$; $n''_2 = 1$.

(3) $\nu = 37494 + n'(921) - n''_1(998) - n''_3(855)$
$n' = 2$; $n''_1 = 0, 1, 2, 3$; $n''_3 = 1, 2$.

(4) $\nu = 37494 + n'(921) - n''_1(998) - n''_4(1180)$
$n' = 2, 3$; $n''_1 = 0, 1, 2, 3, 4, 5, 6$; $n''_4 = 1, 2$.

A fact which strongly corroborates the above arrangement is that more than half of the fluorescence bands originate on the $n' = 2$ level, the wave-length of which in absorption, 2540 A., is very close to the intense line at 2537 A. in the mercury arc, the source of illumination in the fluorescence experiments.

In view of the relatively low accuracy of the above data, it is not possible to calculate the quadratic terms which are to be expected for a non-harmonic vibrator, although experience indicates that this factor is relatively small for organic molecules. As it is, the agreement between observed and calculated values is quite satisfactory. C. V. SHAPIRO
(National Research Fellow).

Physikalisch-Chemisches
Institut der Universität, Zürich, July 29.

Optical Investigations of the Passivity of Metals.

THERE have been published in NATURE communications by Evans (**118**, 51; 1926: **121**, 351; 1928) and Constable (**120**, 769; 1927: **123**, 569; 1929) showing that the passivity of metals is due to a film of oxide. It may therefore be of interest to record that I have been doing experiments similar to those of Freundlich, Patscheke, and Zocher (*Zeitschr. f. phys. Chem.*, **128**, 321; 1927: **130**, 289; 1927), investigating the state of polarisation of light reflected by mirrors of iron or nickel, which were made passive or activated by an electric current in aqueous solutions.

On passivation, the polarisation of the light changed in the same sense as in the experiments of Freundlich, Patscheke, and Zocher, when they brought an iron mirror out of a vacuum into air. If I made the metal passive and active alternately, the optical constants did not return to the same state as before passivation; there was always a small increase in the thickness of the oxide film itself. This cannot be explained on the assumption that passivation is only a change in the state of the metal or caused by an oxygen film on the surface, for in that event activation would simply be the reverse of passivation. These experiments show that the oxide film is not totally destroyed on activation; it only seems to get porous and spongy, whereas on passivation the holes in the film are refilled with oxide, the film itself growing thicker.

These experiments were performed in the Kaiser Wilhelm-Institut für physikalische Chemie und Elektrochemie, Berlin-Dahlem. The complete results are to be published in the *Zeitschrift für physikalische Chemie*.

L. TRONSTAD.

Royal Technical Institute of Norway,
Trondhjem, July 5.

The Number of Excited Atoms and the Absorption Spectrum of Nickel Vapour.

THE equation $N^1/N = e^{-E/RT}$, where N^1 is the number of excited atoms, N the total number of atoms, E the energy, R the gas constant, and T the absolute temperature, was applied by Dr. Loyarte and myself in the case of the absorption spectrum of tin vapour, with good agreement with experimental results (*Phys. Zeit.*, **30**, 68; 1929). In this case it is only necessary to consider the numerical values of spectral terms, because these are originated by the same electronic configuration.

In the arc spectrum of nickel the lowest terms are originated by two electronic configurations. The normal atom gives $^3F_{432}$ and the other lowest terms, $^3D_{321}$ and $^1D_2$, are originated by $(3d)^9\,(4s)$, but the levels $^3\overline{D}$ are entirely encompassed by those of ^3F. The absorption spectrum of nickel vapour at 2500° absolute shows as strong absorption lines only those originated in ^3F levels, with preference for the fundamental term $^3F_4$; the lines of $^3\overline{D}$ and $^1\overline{D}$ levels are of medium or faint intensities. The explanation of this fact is the following. The values of N^1/N calculated considering only the numerical values of terms are not true, because it is necessary to calculate also the energy consumed in passing from one normal configuration to the other: $(3d)^8(4s)^2 \longrightarrow (3d)^9(4s) = \Delta E$, and the corrected equation is therefore:

$$N^1/N = e^{-(E+\Delta E)/RT}.$$

ADOLFO T. WILLIAMS.

Instituto de Física, Universidad de La Plata,
R. Argentina, June 27.

Reflection of Polarised Light.

WHILE experimenting with a pair of silvered glasses, as in the Edser and Butler method of calibrating a spectroscope, I found that if the films are rotated about an axis either parallel or perpendicular to the slit of the spectroscope, a second line appears alongside each line seen and gradually moves to a point midway between each as the angle of incidence of the light is increased. The light forming these two lines is found to be polarised perpendicular and parallel respectively to the axis of rotation, and the relative sharpness appears to vary with the condition of the surfaces.

The explanation appears to be that on reflection at the first silver surface the light is resolved into two polarised components, one perpendicular and the other parallel to the plane of incidence. These two

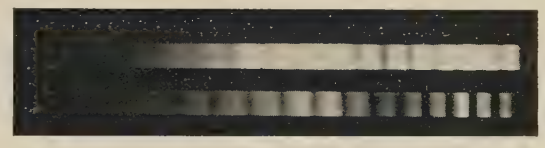

FIG. 1.

components are reflected at each surface with different phase changes and therefore the wave-length at which bright lines appear is different for each component. This effect does not appear to have been noticed before and therefore is undergoing further investigation. The accompanying photographs (Fig. 1) were taken with plane polarised light, in one case perpendicular and in the other parallel to the axis of rotation of the films.

A. CHRISTOPHER G. BEACH.

Chelsea Polytechnic,
London, S.W., July 15.

Geological Age of the Rostro-carinates.

IN reference to my friend Prof. Fairfield Osborn's remark in NATURE (Aug. 31, p. 345), I may say that Sir Ray Lankester's final opinion upon the age of the rostro-carinate flint implements, found beneath the Red Crag, was that they, and the Suffolk Bone Bed from which they were derived, are to be regarded, so far as East Anglia is concerned, as falling within the latest Pliocene, while he looked upon the Crag which surmounts the Bone Bed as being referable to the earliest Pleistocene. This, also, is my opinion.

The descriptive term 'rostro-carinate' was invented by Sir Ray Lankester, and first used by him in *Phil. Trans.*, B, vol. 202, pp. 283-336.

J. REID MOIR.

Occurrence of Sea-urchins on the Foreshore in Britain.

IN July of this year I noticed several specimens of *Echinus esculentus* on the foreshore at Robin Hood's Bay, Yorkshire, well above the low-water level of all tides. In every case they were on flat reefs without any shelter from overhanging ledges. While constantly searching under ledges for other organisms, I never saw an urchin in such a position. Specimens were seen on dark clay shales of the Lower Lias and on the more sandy Middle Lias of Peak Steel.

C. N. BROMEHEAD.

Geological Survey Office,
14A Parliament Street,
York, Aug. 12.

Geological Surveys and Development.[1]

By Sir ALBERT E. KITSON, C.M.G., C.B.E.

THE importance and value of a geological survey to a country has long been recognised by all progressive nations that desire to utilise the mineral resources with which Nature has endowed them. But though such value is fully appreciated and freely acknowledged by all thoughtful, observant people, the nation as a whole has no understanding of it, and no definite views on the matter. The rapid advance of science, and the application of the wonders of science to industry, in practically all divisions of the activities of mankind, are incontrovertible facts, and no nation or community under present-day conditions can afford to neglect to utilise all the assistance that science can give towards increase in production and reduction in cost of the fruits of the industries upon which that nation is mainly or largely dependent for its existence and advancement.

Where the question of cost is not an insuperable barrier to its establishment, a geological survey is formed. As regards our Empire, not only Great Britain, but also the British Dominions—India, Canada, Newfoundland, Australia, New Zealand, and South Africa—long since established such surveys and recognised their value. The Colonies and Protectorates that now have geological surveys in full operation and doing valuable work are Nigeria, the Gold Coast, and Sierra Leone in West Africa; in Central and East Africa—Uganda and Nyasaland, with the Anglo-Egyptian Sudan, and the Mandated Territory of Tanganyika; and the Federated Malay States. Among those which have had surveys for certain periods, but which have been varied, suspended, or concluded, are Jamaica, British Honduras, British Guiana, Gambia, Somaliland, Zanzibar, Ceylon, and the Falkland Islands. Geological advice is being given in Ceylon, Palestine, and Somaliland. In those now without surveys much useful work was done, and the discontinuance of operations was due to various causes.

There is a great deal of misconception regarding the functions of a geological survey, using the term geological in its broadest sense. By many it is thought to deal with the rocks of a country, to describe them, and to show on maps and in reports their divisions, disposition, and distribution; perhaps also to include the economic minerals, such as coal, brown coal, lignite, rock-salt, ores of iron, manganese, copper, nickel, zinc and lead; or valuable gem-stones, such as diamonds, rubies, sapphires, and opals. But there is very little, if any, recognition of the great part that geology plays in a most unobstrusive manner in connexion with mining, agriculture, stock-raising, water supply, forestry, public works, sanitation, geography, and education.

The importance of the remote possessions of a great Empire is dependent upon many factors—such as natural resources and their situation, physical character of the country, lines of communication and transport, nature of climate, soils and water supply, density and distribution of population, character of the peoples, conditions regarding agriculture and pasturage. To develop these fully there should be a government with wide vision and foresight, capable and energetic, with a broad outlook on possibilities of development, and ready to assist financially and sympathetically all proposals that show reasonable prospects of economic success.

The Colonies and Protectorates of the British Empire are almost without exception in the tropics. Many of them are wholly or partly in zones which are blessed with an abundant rainfall, and covered with dense forests or low vegetation. Some comprise areas of low rainfall, and, in consequence, have seasonally arid conditions, and little vegetation. A geological survey of the former is necessarily slow, for the dense vegetation and depth of soil effectually obscure the nature of the underlying rocks and what they contain. In such country much time, labour, and expense are necessary to examine carefully the watercourses, by cutting and clearing lines along them and through the dense bush between them. Nevertheless, it should be remembered that such country may have valuable mineral deposits lying hidden within a few yards of any line of traverse through the forest, and merely awaiting discovery. In areas of low rainfall and scanty vegetation, however, the examination of the country is rendered much easier and can be done much more quickly and thoroughly.

FUNCTIONS OF A SURVEY.

Opinions differ as to how the work is to be commenced. One geologist may consider it advisable to make first a series of rapid reconnaissances through the various districts, along natural boundaries such as the coast-line, large rivers, main paths or roads, railways, if any, or through promising belts of country; then later a series of rapid cross-traverses connecting with the first series, and, later still, numbers of others linking the two series in various directions. This method enables him to get, in the quickest manner, a general knowledge of the geology of the country as a whole. The mapping, in detail, of the geology, in conformance with a mathematical scheme of division of the country, can be done later as opportunity offers. Another geologist may prefer to survey in detail certain areas, such as a known mining field, a belt of country, or the main lines of communication, leaving outlying districts for later work.

Both methods have their advantages and disadvantages, but these cannot be discussed here. The particular features of the country and the wishes of the government will determine the system of work.

[1] From the presidential address, entitled "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire", to Section C (Geology) of the British Association, delivered at Johannesburg on July 30.

The following remarks indicate some of the various activities of a survey of a young colony:

Reconnaissances and rapid surveys through the country, noting specially the physiography, nature of rocks with their structural features (anticlines, synclines, strike, dip, foliation, cleavage, jointing, faults, dykes, and reefs), nature, occurrence and testing of minerals in rocks and gravels of streams by crushing and panning. Kinds of soils, nature and volumes of streams regarding irrigation and water-power, underground water supplies, sites for dams and reservoirs, archæological notes, collection of rocks, minerals and concentrates, with general reports on all, and preliminary special reports on mineral deposits and other interesting features.

Detailed surveys and reports on particular areas, deposits and occurrences, such as mentioned in the preceding paragraph.

Special reports on the country along routes of proposed railways, water-power, sanitation, and other matters.

Assistance and advice to other departments on geological matters.

Surface and underground surveys of mines, with reports, maps, and sections.

Advice to mining companies and prospectors on the examination of their mines, areas, and specimens of rocks and minerals.

Assays, analyses and other determinations of samples of minerals collected by the survey, or received from the public, with reports on them.

Advice to Government regarding operations of prospectors and prevention of fraudulent flotation of companies.

Assistance to educational institutions by information supplied and descriptive museum collections.

Scientific (mainly geological and geographical) reports, with microscopical and chemical descriptions of rocks, maps, and photographs.

Special examination of minerals in concentrates and reports on them.

Publication of reports, maps, sections, assays, analyses, etc.

Formation of a geological museum, mainly of practical geology, with descriptions and uses of the materials therein.

There are numbers of other kinds of geological work that need enlargements of the staffs of the geological surveys before they can be undertaken, such as observations with regard to transport of sediment and chemical character of water in streams; inland denudation, and coastal erosion; underground flow of water through rocks; and decay of rocks under tropical conditions.

It may be advisable to describe very briefly the main features of the method adopted in the Gold Coast in the rapid examination of country possessing no reliable maps.

Traverses are made, by bicycle mainly, with (*a*) the prismatic or pocket compass, for direction; (*b*) cyclometer, or measuring wheel, for distance; (*c*) aneroid barometer, with thermometer attached, for altitude and temperature; and (*d*) watch, for time.

On leaving a camp all four observations are taken, but instead of the traverse being tabulated in columns as usual—which method gives no graphic idea of the orientation of the traverse—the graphic method is used. This shows at once the direction being taken, for the bearing of each line is roughly plotted in the field-book, as to direction and length, and a continuous traverse obtained, in which, in its relative position, each natural feature is placed. The observations embrace features, such as sites of camps, and prominent landmarks, edges of stream flats and banks, water-levels, gullies, tops of rises or ridges or plateaux, edges of plateaux or hills, huts, villages, outcrops of rocks, showing dips, strikes, characters, and any special features. All four observations (*a–d*) are taken at each of such places, except the occasional omission of that for time when stoppages are frequent. But at places where the stoppage is for ten minutes or more, the time observation also is taken on leaving, for the purpose of correction for altitude because of change in air-pressure.

So far as possible, samples of the gravels of all streams, as well as the loam beside outcrops of quartz reefs and dykes, and the material from road-gutters or paths, are panned, and concentrates of heavy minerals obtained. (In certain types of country panning is the most useful aid to prospecting, not only in the discovery of gems and stable metallic minerals, such as native gold, platinoid minerals, oxides of tin, thorium, titanium, iron, chromium, tungsten, and manganese, but also of many rock-forming minerals, which indicate the probable character of the rocks at the spot, or in the basin of the stream tested.) Specimens of rocks and samples of quartz are collected for reference, museum purposes, microscopic examination of thin sections, or testing by assay, analysis, or other methods. Coal, lignite, limestone, and other economic rocks, brick and pottery clays, and pigments are sought; also fossils, which, if found, are used to determine the age of the strata associated with them.

In addition to the general observations indicated, notes are made of the colour, kind, and thickness of soil, the nature of the vegetation, size and kind of stream and gravel, and measurement of volume of water—when there is opportunity, and if of possible economic value, with regard to domestic supplies and possible hydro-electric power and irrigation.

It will thus be seen that the geologist in a new country, by taking the opportunity to make the observations mentioned in the last section, is helping his colleagues in other departments by collecting evidence of probable future value.

It may be specially mentioned here that not only on the economic mineral side of geology is a geological survey of value to a colony. It is also of much assistance to such departments as agriculture, forestry, water supply, and public works, as indicated previously.

Agriculture and Forestry.—The growth of plants, whether grasses, herbs or trees, is dependent on the chemical and physical properties of the soil, on the configuration of the land, and on climatic and other conditions. Since plant foods consist largely of certain rock-forming minerals in a soluble condition, it is necessary to know what is the chemical character of the soil. This can be ascertained by

analyses of samples collected by geologists, for much of the value of the analyses depends upon a careful determination of the types of rock forming the base of the subsoil.

There is, however, another aspect to be considered. Many soils are not sedentary ones—derived directly from the underlying rocks—but are soils of transport. The character of the soil, or even the subsoil, often bears no genetic relation to the underlying rocks, and where such soil is of no great thickness, a geological knowledge of the rocks underlying it is necessary. In connexion with irrigation, the character of the soil of the supply channels needs the attention of the geologist. He should note if there is any crust of minerals on the soil, on the evaporation of water. If so, these minerals should be analysed to see if they are those injurious to plants, when in large proportion, such as certain sodium and magnesium salts. This is important in areas with soil derived directly from rocks of marine origin, particularly young clays, mudstones and sands deposited in brackish lagoons and estuaries. If these minerals be present, he may be able to devise means by which the proportion of these harmful salts when in solution can be steadily reduced by flowing away with the water, and not being alternately and continuously precipitated and dissolved.

Water Supply.—This question of water supply is one that concerns some colonies much more than others, but all are affected to some degree. In cases involving the conservation of the water of annual streams, the problem is dependent largely upon geological considerations. But where underground water is sought, whether of the character of an artesian supply, or due to seasonal rains, the problem is a much wider one, and may be difficult to settle satisfactorily. For artesian water, not only the configuration of the country, but also the disposition and nature of the rocks must be known before any conclusion can be formed as to the chances of success in obtaining such supplies. This is essentially a work for the geologist, and even for him it is quite likely that the evidence available in the district may be insufficient—owing to the absence of natural sections—and that he may be compelled to wait for the result of boring done at spots indicated by him. Therefore, it is advisable that a geological report should precede the efforts to obtain permanent water supplies, and not, as so frequently happens, be asked for after one or more costly attempts have failed.

Public Works.—To this department, perhaps, more so than to any other, the geological survey can be of assistance, specially with regard to—

(1) The discovery of rocks, suitable for constructional purposes (such as for houses, bridges, drains, macadam), and of limestone, for lime, mortar, concrete, cement, and house-washes.

(2) The character of the foundations for bridges, large buildings, dams, and breakwaters.

(3) The nature of the rocks in areas where new roads are to be made. This is mainly for possible variations of route with reduction of expense in construction and maintenance.

Hydro-Electric Power.—This question may be regarded as quite outside the duties of a geologist. A little consideration, however, will show that the geologist has a good deal to do with it, especially where the question of dam-building and reservoir formation is concerned. For the construction of a dam, and the formation of a reservoir for hydro-electric purposes, it is of great importance to know the geology of the area and the nature of the rocks, whether soluble (as limestones) or insoluble; porous and brittle, or impervious and firm, and all the variations between; their normal or faulted condition; their disposition, strike and dip, the latter against or with the direction of the current.

The geologist has to help the engineer not only with regard to the suitability of the rocks at the site of the dam, but also in the whole of the area to be occupied by the proposed reservoir.

Sanitation.—Under the usual conditions for the disposal of nightsoil by burial in depots in the neighbourhood, where there is no proper sewerage or sterilisation system, the geological survey is able to help very considerably in the question of sanitation. The risk being run by using contaminated water is illustrated by a case brought under notice some years ago on the Continent. In this the cause of an outbreak of typhoid fever could not be determined until a geologist said it was probably due to a nightsoil depot on the side of a ridge, several hundred yards distant from a spring on the opposite side of that ridge. He was laughed to scorn. But, by pouring water, stained with a permanent dye, on the depot, he proved that the spring was taking the drainage from it. The geologist showed by scientific observation of the strata that the beds were dipping through the ridge from the depot towards the spring.

Some Practical Results from Survey Discoveries.

In order that a clear impression may be gained of the practical results following the activities of these surveys in Colonies, a few remarks may be made regarding the development of certain mineral deposits discovered solely and directly by the geological and mineral surveys of three colonies.

Nigeria.—The mineral survey of Southern Nigeria discovered the large, black coal field in 1909, surveyed it in detail over the greater portion of a length of some 24 miles and width of 10 miles, and prepared a geological-topographical map of the country, showing altitudes, outcrops of coal, and other information. Further work was done later and the coal-bearing area extended considerably. Mining operations by Government were commenced on the largest seam in 1916, and since then development has continued steadily. The total quantity of coal, in round numbers, produced from 1916 to Mar. 31, 1928, is 2,210,000 tons, valued at the mine at £1,282,000. The total net profit to Government to Mar. 31, 1928, is £452,559. The total cost of the geological survey of Nigeria since its inception in 1919 to Mar. 31, 1928, is approximately £68,700, and of the mineral survey of Southern

Nigeria for the period 1903–1913, about £20,000, or a total of approximately £88,700. Thus the total profit to the Government from this one discovery by a Government geologist is more than five times the total cost of the geological and mineral surveys.

Gold Coast.—The specially important discoveries made by the geological survey of the Gold Coast are huge deposits of manganese ore and bauxite (aluminium ore), and widespread alluvial deposits of diamonds. The manganese deposits were found in 1914 before the War, but not exploited until 1916, when the vital need for high-grade manganese ore caused the development of these deposits. Production of ore commenced in 1916, and the total production to Mar. 31, 1928, is 1,785,643 tons of high-grade ore, valued at £3,350,706, free on board ship at Sekondi.

Diamonds were first discovered in February 1919. These diamonds, though small, are of very good quality, and have a ready sale for industrial purposes and jewellery. Since mining operations were commenced in 1921 there has been a large progressive increase each year until, for the year ended Mar. 31, 1929, the figures are: production, 648,343 carats; value, £538,860; export duty paid, nearly £27,000. The total weight of diamonds produced is 1,824,630 carats, valued at £1,758,348, on which the Government has received roundly £87,900 from the export duty of 5 per cent on the total value.

The Gold Coast has a great potential asset in its huge deposits of high grade bauxite—the total conservatively estimated quantity being upwards of 250 million tons. These deposits are not yet developed, owing mainly to the high cost of transport of bauxite to a port of shipment. Bauxite is an ore of low value and so cannot bear heavy charges for freight, but, with extension of railway communication and reduction of freight charges, the Colony should see a great development of this particular source of wealth, and a further mineral example be added to revenue from Geological Survey discoveries.

Sierra Leone.—The Geological Survey of this Colony is much younger than those of Nigeria and the Gold Coast. The Director has discovered large deposits of iron ore (hæmatite) of good quality, and considerable deposits of alluvial platinum and gold—all now being developed—besides occurrences of chromite, corundum, ilmenite, rutile, manganese, and graphite, all of them also minerals of economic value. If found on further examination to occur in promising quantities, these deposits should prove to be of commercial value.

The West African geological surveys have no offices and laboratories in the Colonies. During the dry and tornado seasons of the year, the geologists are engaged on geological surveys and examinations of various kinds in the Colonies, but during the rainy season field work is suspended and the staffs return to England. In these respects their organisation differs from that of the other Colonies. The specimens of rocks and concentrates collected are then examined and distributed for various modes of treatment, and reports not made or completed on the Coast, as well as microscopic examination of thin sections of rocks, are done in London. The greater portion of the chemical work, such as assays and analyses, devolves upon the Imperial College of Science and Technology and the Imperial Institute under special arrangements.

A country difficult to examine because of its natural features cannot be certainly expected to yield its mineral secrets, or confess its paucity of mineral deposits, in the course of a few months, or even years of effort. Let it be borne steadfastly in mind that spectacular discoveries of valuable mineral deposits are not the only benefits that a geological survey can bestow upon a country, however important they may be, and however valuable may be their contributions to the revenue and prosperity of the country.

In this address an attempt has been made to show the value of geological surveys to young countries, and the application of scientific knowledge and methods, both theoretical and practical, to the discovery of the valuable inorganic and organic resources of Nature, as opposed to the search for them in a more or less haphazard manner. To-day science plays the predominant rôle in these revelations, and is steadily forcing a recognition of this fact upon the peoples of the earth, for their common benefit.

The Public Regulation of Wages in Great Britain.[1]

By Prof. HENRY CLAY.

A GREAT change has taken place during the last twenty years in the methods of negotiating wage-changes. In 1910, when the Labour Department of the Board of Trade published the result of an inquiry into collective agreements, it was estimated that 2,400,000 workpeople worked under conditions specifically regulated by such agreements. It is not possible to compute a figure for a recent year to correspond with the 2,400,000 of 1910, because the status of collective bargaining in certain important industries is obscure; but if we add together the numbers covered by trade boards, agricultural wages boards, joint industrial councils, and unions in certain industries, which, like coal and cotton, have adopted none of these forms of organisation, we get a total of eight millions out of a wage-earning population, which, excluding domestic service, numbers something less than fourteen millions. When we remember that the influence of an agreement or a determination, reached by a representative body, tends to go beyond the limits of the membership of the organisations, and even trades, directly represented,

[1] From the presidential address to Section F (Economic Science and Statistics) of the British Association, delivered at Johannesburg on Aug. 2.

we may safely conclude that there are few important gaps left in the provision for the settlement of wages by collective bargaining in Great Britain. Before the War, outside the organised industries, the adjustment was made by the individual action of the employers, who first felt the need; to-day the process of general wage-changes has, we may say, been constitutionalised.

It is the system resulting from this change that I refer to as 'the public regulation of wages'. It is only partially due to the direct intervention of the State, although the legalising of trade union activity was essential to the development of effective collective bargaining without the State's direct intervention. Whether, however, wage-changes are negotiated by voluntary industrial councils, spontaneous negotiations between trade unions and employers' associations, or statutory trade boards and agricultural wages boards, the result is the same. A change cannot be effected without public discussion between representatives; when effected, it applies generally to the trades and occupations represented; it is the outcome of an attempt to allow for all the economic factors in the situation, not of an attempt to impose *a priori* principles of social justice upon industry; it is a procedure for adjusting wages by agreement, rather than a policy aimed at overriding the commercial considerations that have determined wages in the past. It is 'public' in the sense that it involves formal discussion by representatives, and results in publicly formulated standards; it is 'regulation' only in the sense that it provides in this way for the formal consideration of the factors affecting wages by the representatives of employers and wage-earners, and the embodiment of the result in a formal agreement.

The extension of public regulation of wages in this sense from a part to the whole of the field of commercial wage-employment could scarcely be without some effects upon the general industrial situation. In their classic study of collective bargaining, Mr. and Mrs. Webb (now Lord and Lady Passfield) laid chief stress upon its influence in increasing the efficiency of industry. They drew a sharp distinction between restricting numbers in a trade and imposing common rules. Their survey showed that the former policy, anti-social and self-defeating, was adopted by a smaller and smaller proportion of trade unions, and was becoming more and more difficult of application; the discarding of any attempt to restrict numbers, and the concentration on the policy of imposing standard or minimum rates and conditions, was growing, and was the chief characteristic of trade unionism in the expanding industries.

This policy increased industrial efficiency in two ways, by its reaction on the workman and by its reaction on the employer. The workman, prevented from securing employment by accepting a lower rate of pay than his competitors, was compelled to improve his efficiency, and was enabled to do so by the increase in income and security that trade unionism usually brought. More important were the reactions on the employer. Stopped from taking the easy but dangerous path to lower costs of cutting wages, he had to find other means of increasing output in relation to wage-payments. Hence trade unionism encouraged an increase in the scale of production, a more extensive use of mechanical equipment, a more eager search for technical improvements, and, generally, the economy of labour. It did not extinguish competition, but diverted it from wages to other factors in costs.

The rapid expansion of the unionised coal, cotton, and engineering industries in the decade following the publication of this analysis seemed to confirm its soundness. The decline and stagnation of the same industries in the last eight years prompts the inquiry whether this influence has exhausted its potentialities.

Whether the influence on efficiency has continued and is general, the abnormal condition of British industry makes it difficult to decide. The large amount of short time, the increase in other costs, and the financial difficulties which prevent large numbers of firms from installing improvements, which they would like to install, all obscure the issue.

Contemporary experience of America shows that collective bargaining is not a necessary condition or the only means of stimulating an increase in efficiency. In so far as the extension of collective bargaining does stimulate or compel economy in labour—and, if it has not done so on any large scale at present, it may do so in the near future—it may maintain wages at the expense of increasing unemployment. In the great export industries of coal and cotton, for example, demand for British production appears to be inelastic, and considerable reductions in cost have not resulted in any substantial increase in employment. Moreover, much of the employment at present given is given at a loss.

A reorganisation that made it possible to maintain present wage-rates without loss would probably, therefore, involve a reduction in the numbers to whom employment could be given. Such an extrusion of unwanted labour, as a result of improvements in the technical processes or organisation of industry, is a normal incident of economic progress; and the hardship it may involve need be only temporary, provided that the expansion of industry as a whole is great enough and rapid enough to absorb the extruded labour. When all the industries of the country adopt collective bargaining, and all begin to adopt the policy of holding up wage-rates, leaving it to the employers to tune up industry to the pitch at which such rates can be paid, the numbers of extruded workers for whom the new and expanding industries have to find employment is likely to be increased, and the rate of expansion of industry as a whole becomes a factor of much wider and more pressing interest in wage-negotiations than before.

It is obvious that an advance in wages secured by any one class of workpeople, if it is not covered by a corresponding increase in the efficiency of the industry in which they are engaged, must be a

the expense of someone else. The increased efficiency may be due to the workpeople or to the employers; but, if neither of them create a fund from which increased wages can be paid, the increase will be paid either by consumers or by the co-operating industries that help them to supply the consumers. If the increase is merely sufficient to keep pace with an advance in the average level of wages, it may represent no more than the industry's proportionate share in the general increase of wealth; if, however, it is greater than the average, or in times of wage-reductions the reduction is less than the average, it must involve the diversion to the favoured industry of a larger share of society's income.

Such a diversion may be effected without overt restriction of numbers. If a union—or a trade board or arbitration authority—fix wage-rates in an industry at a level which makes it impossible for the industry to employ all the workpeople seeking work, and maintains rates at that level, it will immediately restrict employment, and ultimately may so discourage entry to the industry that the number of workpeople dependent on the industry is no greater than can be employed at the rates set. The demand for the products of industry, and therefore for labour, ebbs and flows with general fluctuations in trade; a strong union can maintain rates when demand ebbs and advance them when demand rises, thus preventing both a fall in *rates* proportionate to the general decline in money incomes in the depression, and an expansion in *numbers* proportionate to the general increase in production when trade improves. On the other hand, an unorganised industry may suffer a reduction of rates when trade declines and an expansion of numbers, on the low level of wages so established, when trade improves.

The mere regulation of wage-rates may, therefore, be restrictive in its effects. Such restriction may be legitimate and socially desirable; but it destroys any sharp distinction and opposition between a policy of restriction of numbers and a policy of imposing common rules of payment and conditions. It is not even clear that the reactions upon efficiency of the two policies are necessarily different. If the supply of a certain class of labour is restricted, employers will be stimulated to devise labour-saving appliances to substitute for it, or some reorganisation to dispense with it, just as certainly as if the supply is unrestricted but expensive.

Trade union control of wages, and the analogous control by public wage-fixing authorities, may be most simply regarded as an application of monopoly price policy to labour. The monopoly is seldom, if ever, complete; but what monopoly is? It gives the seller of labour no control over the demand for his services; it merely enables him, so far as it is effective, to select the point on the demand curve at which he will hold the price, until a general rise in demand absorbs at that price all the union members, instead of allowing competition for employment always to force wages down to the point at which the whole supply of labour is absorbed. It is a policy that can be pursued without causing more than temporary unemployment, under two conditions; first, that the wealth of society is steadily growing, so that continually higher wage-rates can be paid without causing unemployment: secondly, that it is practised only by a minority of the trades in the community. The latter condition no longer obtains.

So long as everybody was not organised to attempt it, it was always possible that favoured trades, by means of a monopolistic organisation, might secure for themselves a larger share of the final price received for industry's products. All now are organised, or provided by the Government with equivalent protection; all are able to set and hold rates of wages, as firmly as the minority of well-organised trades were able to hold them before the War.

Partial and sporadic monopolistic organisation has been displaced by universal control. Two consequences follow. First, it is no longer possible for well-organised trades, merely by virtue of their trade union organisation, to secure differential gains at the expense of unorganised or ill-organised groups with whom they co-operate; or, if it is still possible, at any rate it is more difficult. In the second place, influences upon wages that were formerly counteracted by trade union organisation have now free play.

From this point of view the intervention of the State, in establishing trade boards and agricultural wages boards and in other ways, and the contemporary extension of unionism to hitherto unorganised trades, takes on a rather different aspect from that which Mr. and Mrs. Webb put upon it. They represented it rather as an extension to the rest of industry of the principle of trade union control and of the benefits that they had shown to follow from trade union organisation. This, of course, it was; but it was at the same time a necessary corrective of trade union influence. So long as only a part of the field of wage-employment is covered by trade union organisation, the benefits secured by trade unionists may in part be at the expense of the workpeople in the unorganised part of the field; so far as those benefits are not the return of increased efficiency due to union pressure, they will almost certainly be in part at the expense of other wage-earners.

The second consequence of general control is the release of influences upon wages which were formerly prevented from exercising their full potential effect. In this release is, I think, to be found a partial explanation of the changed relations which wages in different industries bear to one another since the War. It might have been expected, for example, that wages would be high in an industry like railway transport, which enjoys a monopoly and has a relatively inelastic demand for labour. In fact, before the War they were low; since then the railwaymen have had the advantage of effective union organisation, and their wages have risen disproportionately to others, in spite of the invasion of the railways' monopoly by road transport and consequent depression of the industry.

Another influence is 'shelter' from foreign competition, possibly only a temporary influence, but one that has operated throughout the post-War depression.

The extension of trade union or Government control over the whole field of commercial wage-employment has cancelled an advantage, which the workpeople in the organised trades used to possess, and, by so doing, has increased the relative influence which other elements of monopoly or bargaining-advantage exercise upon wages. The extension would be an almost unqualified improvement if its effect was to confine wage-claims to amounts that could be justified by the increased efficiency of industry, to which the control of wages contributed. Since, however, there are other conditions, which enable or encourage one trade to profit at the expense of others, and since the different controlling authorities carry on the pre-War trade union tradition of considering only the needs and possibilities of their own trade, the general extension of control may result in a general attempt to secure more wages than can be paid.

The increased element of publicity and public control of wages will tend to harden wage-rates in a depression, provided that the representatives of the wage-earners really wish to resist reductions. Whether they will do so or not, however, will depend on the consequences of successful resistance. Before the War the consequence would have been unemployment; and unemployment would have involved, for the small minority of wage-earners covered by trade union unemployment insurance, a drain on the union funds; for the great mass of wage-earners, who had no such resource, early and extreme hardship. It was impossible for the representatives of the wage-earners in wage-negotiations to ignore unemployment.

To-day things are different. Successful resistance to a reduction may still involve unemployment, but unemployment does not involve the same certainty or degree of distress. Before the War the provision for unemployment relief was partial and inadequate. To-day there is a system of unemployment relief that covers all the industries that are liable to serious unemployment. Then the spokesmen of the wage-earners had to consider the employment situation, because their clients would be the chief sufferers, if their wage-policy restricted employment; now, in such a case, they may nevertheless persist in their policy, since they are conscious that their clients are not without resources, if all cannot be employed at the level of wages exacted.

This comparative disregard of unemployment in wage determinations is as distinctive a change from pre-War practice as the extension of collective bargaining, and much more significant for the problem we are now examining. It is the principal and direct explanation of the loss of plasticity in wage-rates. It should be noted, however, that the provision of unemployment relief is not the only cause of the change. The post-War depression in many industries is so much deeper and more widespread that any practicable reduction in wage-rates would scarcely affect it. The example of the coal industry, in which a substantial reduction in wage-rates has been followed by increase in unemployment—and in losses by the employing firms—is pointed to as evidence of the futility of wage-reductions; and no attempt is made to gauge the extent to which demand is as inelastic for the products of other industries as it has proved to be for coal.

There is an explanation for the wage-earner's attitude in yet another change; wage-rates of direct labour never were the sole determinant of costs, and to-day they are probably less important than before the War. Loan charges are still proportionately much heavier than before the War; rates and taxes and social insurance contributions are much heavier; indirect costs for transport, financial services, etc., are higher; distributing costs have increased disproportionately. Hence the wage-earner, asked for concessions, fears that he is being asked to make a sacrifice, not to revive trade, but to lessen the losses, or increase of profits, of retailers, banks, loanholders, railways, and co-operating industries, that may be more prosperous than his own.

The consideration of wages is purely sectional, industry by industry and trade by trade; the need of industry, so far as wage-adjustments can meet it, is for an all-round reduction, which will affect the indirect costs, simultaneously with the direct costs, of every industry. No machinery exists for such co-ordinated and synchronised adjustment; on the contrary, the extension of collective bargaining has probably intensified and extended the influence of this sectional outlook of industry, by enabling industries, that before the War could not have resisted the pressure imposed by general trade depression, to hold up wages.

It would appear that wage-fixing authorities, acting independently of one another and disregarding the general economic situation, are maintaining wage-rates at a level at which existing industries cannot provide full employment; the considerations that explain their policy will not serve to explain away the unemployment that has accompanied it. The outlet for labour thus excluded, which was provided before the War by industries in which wages were not controlled, no longer exists. There remains for examination the possibility that new industries may provide an outlet, industry as a whole expanding sufficiently to absorb the excluded labour.

It would seem that industry has, temporarily at any rate, lost its capacity of expansion. In certain directions there is expansion, but a closer examination compels us to discount any hopes derived from it. The largest single increase in employment has been offered by retail distribution, 360,000 or 31 per cent between 1923 and 1928. The Balfour Committee brought together material that suggests that retail distributing costs rose in greater proportion than prices generally between 1914 and 1925; since then we have had a further great increase in the number of insured persons employed in retail distribution. This expansion of the retail

margin has been sufficient to neutralise much of the writing down of capital, reduction of wages, and economies of re-organisation by which productive costs have been reduced. By keeping up the cost of living, while wholesale prices are falling, these costs also make it difficult to ask for any reduction in wages. So far, then, as retail distribution provides additional employment by its expansion, it probably does not succeed in compensating for reduction in industrial employment, which the cost it imposes on industry involves.

The second group of expanding industries is the building, building material, and furnishing industries. Together these account for 211,000 increase in the five years. The War-time arrears have now been made up, so that further expansion will be limited to the needs of the increase in population and of replacement with the aid of further subsidies. The case of the third group is similar. These are industries in which expansion has been stimulated by protection, but would have taken place without that stimulus, under the more economic stimulus of technical invention; motor manufacture and artificial silk are the chief members of the group. It is difficult to estimate how much of the growth was dependent on protection and merely a diversion from unprotected industries; but the aggregate expansion of the two together would not be sufficient to compensate for half the contraction in coal alone.

It remains in conclusion to point out that the loss of plasticity, and the adverse effects upon employment that may follow, are not necessary and inevitable consequences of the extension of collective settlements, but, in so far as they are attributable to it, due rather to an obvious defect in the machinery and current practice of collective bargaining than to anything inherent in collective bargaining as such.

The defect in the machinery for wage-negotiation to which the present unemployment points is the purely sectional character of its deliberations. It is no one's business to consider wages as a whole: there is no authority charged with the duty of reminding wages boards of their responsibility to industry in general. Collective bargaining must fail in securing an accurate adjustment of wages to industrial conditions so long as it is confined to negotiations over wages in individual trades and industries. If it is to continue, it must be supplemented by some device for ensuring that the negotiators in each trade and industry have regard to the effect of their determinations upon other trades and industries, and for compelling them to contemplate the needs of industry as a whole.

Moreover, by considering only its own needs and interests, an industry might pursue a policy that was restrictive in effect, though regulative in form. If all industries and all trades pursue such a policy —and all now have the requisite organisation— and maintain rates of wages that restrict employment, there will be excluded a mass of workers who must either be absorbed by new industries or remain unemployed. If there are new industries capable of absorbing them, well and good; but at the present time it would seem that there are not. The index or barometer, therefore, to which trade union and arbitration authorities' attention should be directed, is not solely, or even principally, unemployment in the industry immediately under consideration, but the rate of expansion of industry as a whole.

The task of co-ordinating wage-settlements in different industries, and of securing in each the consideration of such apparently remote factors as the productivity and rate of expansion of industry as a whole, may be too much for the spontaneous democratic machinery by which collective settlements are negotiated at present; but the alternative is almost certainly a breakdown of that machinery under the pressure of a growing problem of unemployment.

Obituary.

DR. E. S. BIELER.

A TELEGRAM from the Prime Minister of Australia, sent on July 26, announced the death of E. S. Bieler on the previous day from pneumonia. He died after thirty-two hours' illness at Geraldton, Western Australia, at the age of thirty-five. He was engaged with Dr. Boughton Edge and others in geophysical exploration under the joint auspices of the British Empire Marketing Board and the Commonwealth of Australia. He had received two years' leave of absence from McGill University for this important expedition.

Educated at Montreal High School, Bieler became a distinguished honour student in mathematics and physics at McGill University. Soon after the War began he joined the First McGill University Company and then served with the Princess Patricia's Light Infantry, receiving a commission in the Canadian Field Artillery. After being twice wounded he was transferred to the Anti-submarine Division and worked under Sir William Bragg at applied research methods at Scapa Flow and on the north coast of France. After the War he received an 1851 Exhibition Scholarship and went to Caius College, Cambridge, working as a research student at the Cavendish Laboratory at a time when Sir Ernest Rutherford and Dr. J. Chadwick were bombarding the nuclei of atoms with alpha particles.

The idea of a barrier round the nucleus resulted from this work and Rutherford has spoken to me with enthusiasm of Bieler's research. After taking his Ph.D. degree at Cambridge he became assistant professor of physics at McGill, and he directed his attention to the susceptibilities of the alkali metals and the Hall effect in them, believing that the greatest progress could be made in that manner. He communicated some admirable summaries on magnetism and on the Fermi-Dirac theory to the *Journal of the Franklin Institute*; and published papers also on electrical measurements.

Bieler had, in 1917, done research work in

acoustics at Father Point with Dr. L. V. King, to whom he was indebted for much of his training in mathematics and physics. He also became interested in geophysical prospecting in northern Quebec, and with Mr. H. G. I. Watson invented and patented a method for searching for ore bodies by measuring the ratio of the axis minor to the axis major of the ellipse of polarisation. He was thus by experience well equipped to become deputy director of the geophysical expedition, and his life in camp and in the Canadian bush seemed a guarantee of physical fitness also. He was a man of eagerness and enthusiasm with well-balanced judgment and sound scientific acumen. His family and his friends and colleagues have lost a man of sterling character and McGill University has lost a physicist hard indeed to replace. A. S. EVE.

WE regret to announce the following deaths:

Sir Alfred Bateman, K.C.M.G., formerly Comptroller-General of Commerce, Trade and Statistics of the Board of Trade and president in 1897 of the Royal Statistical Society, on Aug. 7, aged eighty-four years.

Prof. L. H. Cooke, professor of mine surveying at the Imperial College of Science and author of many improvements and inventions relating to surveying instruments, on Aug. 23.

Prof. Thomas Eagleson Gordon, president of the Royal College of Surgeons in Ireland and professor of surgery at Trinity College, Dublin, on July 24, aged sixty-two years.

Dr. Paul A. Lewis, of the Department of Animal Pathology of the Rockefeller Institute for Medical Research, known for work on immunisation and related subjects, who died of yellow fever while studying that disease in Brazil, on June 30, aged fifty years.

Prof. John A. Mandel, professor of chemistry and physiological chemistry in the University and Bellevue Hospital Medical College, New York, who worked mainly at the chemistry of the nucleic acids, on May 5, aged sixty-three years.

Rear-Admiral Albert P. Niblack, K.C.M.G., C.V.O., United States Navy (retired), president since 1927 of the Directing Committee of the International Hydrographic Bureau, on Aug. 20, aged seventy years.

Karl Auer, Ritter von Welsbach, inventor of the incandescent gas light and of the osmium filament electric lamp, on Aug. 4, aged seventy years.

News and Views.

ON Sept. 7 occur the centenaries of the births of the American geologist Hayden and the German chemist Kekulé. Ferdinand Vandeveer Hayden, who was born at Westfield, Mass., graduated from Oberlin College, and in 1853 took his M.D. at Albany College, and by James Hall was induced to join an exploring party to Nebraska. During the Civil War he served as a surgeon, in 1865 became professor of geology in the University of Pennsylvania, and for twelve years, 1867–79, was geologist in charge of the United States Geological Survey of the Territories. His labours resulted in a most valuable series of reports in all branches of national history and economic science. He first made known the basalt plateau in Oregon and Washington through which the Columbia River had channelled its course; he described in 1871 the wonderful lava plateau in north-western Wyoming on the banks of the Yellowstone River, with geysers, hot springs, mud volcanoes, and extinct volcanic hills, and the idea of the great National Yellowstone Park was his. Hayden died at Philadelphia on Dec. 22, 1887, and the following year his widow endowed the Hayden Medal of the Academy of Natural Sciences of Philadelphia for work in geology or palæontology, among the recipients of which have been Suess, Huxley, Daubreé, and Geikie.

FRIEDRICH AUGUST KEKULÉ, also born on Sept. 7, 1829, was sent from the Darmstadt Gymnasium to Giessen to study architecture. He had already displayed remarkable ability and at Giessen was attracted to chemistry by the lectures of Liebig. At twenty-one years of age he published his first piece of research. A year spent in Paris led to an acquaintance with Dumas, Wurtz, Cahours, Regnault, and with Gerhardt, whose treatise on organic chemistry he read in manuscript. A year or two later Kekulé became assistant to Stenhouse at St. Bartholomew's Hospital, London, and it was in London, as is known from his addresses, that his ideas with regard to structural chemistry began to take shape. In 1856 he became a privat docent at Heidelberg; in 1859 professor of chemistry in the University of Ghent, and in 1867 he was called to Bonn, where he found himself head of the palatial laboratory just erected to Hofmann's design. Kekulé had already in 1858 published his views on the linking of atoms, and in 1865 his memoir on the theory of the structure of benzene, containing what Japp in 1898 called the most brilliant piece of scientific prediction in the whole range of chemistry. Distinguished as a thinker, teacher, and investigator, Kekulé's merits never lacked recognition; he was feted three times by his students, and in 1895 the German Emperor ennobled him with the title Kekule von Stradonitz. It was then he dropped the accent on the final e. He died of heart failure on July 13, 1896, and seven years later his statue was erected in front of the laboratory at Bonn. Among his students were Baeyer, Ladenburg, Dewar, Thorpe, Van 't Hoff, and Japp, the last of whom in 1898 delivered the Kekulé Memorial Lecture to the Chemical Society.

THE estate of the late Mr. Oldfield Thomas, who died on June 16 last, has been sworn for probate at £42,613, with net personalty £37,374. By his will and four codicils he made numerous bequests for scientific and charitable purposes. Among these the most interesting are legacies of £500 each to the Society for the Promotion of Nature Reserves and the London Playing Fields Society, £300 to the National Lending Library for the Blind, £200 each to the Decimal Association and the Nature Cure Association, and £100 to the Simplified Spelling Society. To the

Trustees of the British Museum (Natural History) he has bequeathed his portrait by J. E. Breun in 1904, "to hang, if permitted, in the Mammal Room; . . . any zoological specimens I may be possessed of together with the cabinets or boxes containing them; . . . my collection of zoological tracts and scientific books for the special use of the Assistant in charge of the Mammalia in the Museum"; and £1000 "for the express purpose of constructing a light passenger lift for the use of the staff from the hall or basement of the Museum to the second floor, in case it shall not have been constructed in my lifetime". The testator says: "Such a lift would greatly facilitate the work of the Museum and at the same time lengthen the period of life during which assistants and helpers as they become older would be able to carry on their work at the Museum. The loss of assistance, especially unpaid assistance, that I have known occasioned by the want of such a lift has been by no means inconsiderable." The residue, expected to amount to about £12,000, is left in trust for the trustees of the Godman Exploration Fund, who are directed to use the income "in their absolute discretion for the benefit and increase of any of the Museum collections".

ATTENTION is directed in the annual report of H.M. Chief Inspector of Factories for 1928 (London: H.M. Stationery Office) to the fact that the engineering industry in the south of England, particularly in the neighbourhood of London, is expanding very rapidly. This is the main reason why the population between Acton and Slough has increased two and a half times during the last five years. Of the accidents reported due to electrical shock, 37 (3 fatal) arose from the careless handling of portable apparatus. There can be no doubt that these accidents are due to the ease with which a portable electric lamp can be improvised by anyone having only a rudimentary knowledge of electricity. Electrical engineers now consider damp plaster or concrete which is in contact with 'live' metal as itself alive and take precautions accordingly. They now insist that all exposed metal in bathrooms which is liable to become alive in the event of defective insulation of a neighbouring pipe must not only be earthed but must also be placed out of reach of a person standing in the bath. At very high pressures there were 34 accidents (7 fatal). In most of these cases the men responsible were competent and experienced. They suffered apparently from momentary forgetfulness or lack of care. At pressures below 250 volts, that is, the pressures used in domestic supply, there were 17 fatal accidents, every one of which was due to alternating current. Taking this in conjunction with previous reports, it appears quite certain that alternating current shocks are much more dangerous than direct current ones. It is becoming customary for builders who use electricity for their cranes and lighting during constructional work to convert the alternating current obtained from the public mains to direct current at 110 volts, before it is connected with their temporary wiring arrangements.

MR. WILLIAM COLLARD gives an interesting account in *World Power* for August of the London and Paris Railway scheme. Briefly stated, the proposal is to construct a high speed electric railway connecting Paris and London. Under the Channel there would be two tube tunnels. In order that the scheme should be commercially profitable, it is necessary that the twin tubes should be utilised to the utmost and that the traffic load should be approximately constant. A Government committee is at present examining the economic aspects of the scheme. As the trains are to run at a speed of 120 miles an hour, it is proposed to have a seven-foot gauge so as to ensure safety. The scheme seems to be quite feasible from the electrical point of view. In the modern type of locomotive used on the St. Gothard Railway, there are four motors each of 770 horse-power and each driving an axle. The same locomotive is used for driving an express or a goods train. Owing to the broader gauge, locomotives of at least twice this power could be used through the Channel tube. The journey between London and Boulogne could be performed in 85 minutes, and between London and Paris in 2 hours 45 minutes. The locomotives would be rated at 6000 horse-power. Arrangements would have to be made for hauling only fully loaded goods waggons between London and Paris. Otherwise it would be cheaper to tranship the goods. The proposed railway would run a service between London and Paris at intervals of 45 minutes throughout the day. If this railway were constructed, it would be possible to reach the great majority of Swiss holiday resorts by a daylight service from London. Doubtless also there would be one-day return tickets to Paris.

IN the early days of electric supply, the sudden demand for energy at certain periods of the day and its equally sudden cessation made it necessary for the engineers to provide plant far in excess of that required if the load were constant and equal to the average load. As a result of the great increase of the demand for electric heating and power purposes, the ratio of the maximum demand at any one time to the average demand has considerably diminished; the usual load curve of a station may show several peaks which occur at various times of the day and often on Sunday morning. In a paper by A. G. Christie, read recently before the American Society of Mechanical Engineers, methods are suggested for diminishing the capital expenditure on plant by providing storage plant for the system which would absorb energy at certain times of the day and give up energy at other times, so as to help the generators. The plant intended for peak load service should be as cheap as possible, as the total cost of this plant consists mainly of capital charges. High level water storage, storage batteries, steam accumulators, and Diesel engines have been suggested. The first and last of these, however, would seldom be applicable. Prof. Christie makes out a strong case for the steam accumulator. In Great Britain the considerable space occupied by steam accumulators would be a drawback. To operate well, also, it is necessary to use special turbines owing to the variation in the steam pressure which occurs in these thermal storage boilers. Anything which makes the plant more

complicated and prevents standardisation is objectionable. The paper, however, is well worth study by supply engineers.

THE Carnegie Institution of Washington was founded by Andrew Carnegie in 1902, the total endowment amounting to 12 million dollars, with an additional income from a reserve fund of 3 million dollars. Its purpose was "to encourage in the broadest and most liberal manner investigation, research, and discovery, and the application of knowledge to the improvement of mankind". At first the activities of the Institution were directed towards the support of a relatively wide range of subjects and grants were made for specific projects covering limited periods, but eventually the tendency veered towards certain major projects the solution of which required longer periods and greater opportunity for the concentration of funds. Now it may be said that the Institution aims at advancing fundamental research in fields not covered by the activities of other agencies. In so doing it concentrates its attention upon specific problems, with the idea of shifting attack from time to time to meet the more pressing needs of research as they develop with increase of knowledge. A special feature has been the publication and prompt dispersal of the Year Books and other works, which now number 600 volumes, to most of the greater libraries of the world. The extent and great variety of main lines along which the Institution is advancing knowledge may be gathered from the summaries of the investigations carried out by a dozen departments, each concerned with its own branch of science and yet working in full co-operation with the others. These summaries appear in the fourteenth issue of "Carnegie Institution of Washington", published in May last.

ANOTHER work, published by the Carnegie Institution of Washington last May, should be at hand for reference by every scientific worker. It is a volume of 202 pages containing a "Classified List of Publications of the Institution". The works are catalogued in three sections: a serial list of publications; lists arranged according to the appropriate branch of science, with a short description of each work following the title; and an alphabetical list of authors with their works. Copies of each publication are sent gratuitously to a carefully selected list of libraries throughout the world, and a list of these libraries will be sent post-paid upon application. The index shows that many of the works are now out of print, but most of these will be found in the libraries in question. Books not otherwise disposed of are for sale at prices approximating to the cost of publication. Scientific workers may obtain price-lists or classified lists, as issued, by furnishing requisite addresses, and special lists of additional papers in reprinted form, relating to the work of the Geophysical Laboratory, Department of Terrestrial Magnetism, and of the Mount Wilson Observatory, are also available.

ON the morning of Aug. 29 the German airship, *Graf Zeppelin*, reached Lakehurst, New Jersey, having completed a 'round-the-world' flight of about 21,000 miles in a little more than twenty-one days. About nine days were spent in resting and refuelling at Friedrichshafen, Tokyo, and Los Angeles, and the actual flying time is given as 27 minutes short of 12 days. The voyage was made in four stages, the first, the eastward journey across the Atlantic, taking just over fifty-five hours. The next stage, from Friedrichshafen to Tokyo, an unbroken flight of about seven thousand miles, constituting a record long-distance flight, took the airship over Berlin and Danzig, between Leningrad and Moscow, north of Tobolsk and across Siberia, and occupied about a hundred hours. Full advantage was taken of favourable winds. From Tokyo across the Pacific took a little more than sixty-eight hours. The speed throughout seems to have been about 70-90 knots an hour, and the passengers speak highly of the comfort of the journey. Dr. Eckener, the commander, is to be congratulated upon the skilful manner in which he handled his ship and upon the successful conclusion of his feat of circumnavigation.

THE Annual Report of the Auckland Institute and Museum for 1928–29 records a most important stage in the development of that institution. During the year, the magnificent new Auckland War Memorial Museum has been completed and furnished with up-to-date cases and fittings, and good progress has been made with the arrangement of the collections. It is believed that by November preparations will be so far advanced that the building may then be formally opened to the public with appropriate ceremony. It is a fitting occasion for rejoicing, for not only are the collections, brought together in the course of sixty years by the members of the Auckland Institute, to be finely housed, but, a matter of as great significance, the responsibility of their upkeep has been enormously widened through the voluntary accession of twenty-five local bodies. These, with the Auckland City Council, form a unified body created by the Auckland War Memorial Museum Maintenance Act, and the new arrangement should not only add to the financial security of the Museum, but should also guarantee a wider interest in, and greater educational use of, the collections.

WE have received the first two numbers of a new journal for theoretical and applied genetics entitled *Die Züchter*. It is edited by Erwin Baur, and the first number contains on the title-page a figure of his new institute for breeding-research at Müncheberg. The journal appears monthly, each part containing at least 32 pages. The publishers, Messrs. J. Springer of Berlin, announce the price as 30 marks per year or 3 marks for each part. Printed on smooth paper, the journal is well illustrated, and its aim is apparently to keep practical plant and animal breeders in touch with the progress of genetics. That this aim is interpreted in a broad sense and that new results in genetics are also included, is shown by the contents of the first two numbers. An article by Bělař on breeding and cytology points out the importance of chromosome investigations, particularly to plant breeders. Another, by H. Stubbe, summarises the recent work of Muller, Goodspeed, and others in producing mutations in animals and plants by the action

of X-rays. Other short articles are concerned respectively with crosses between Roumanian Mangalitza and German breeds of pigs, with xenia in cereals, and with the production of potato varieties immune to wart disease. A short account is given of the Russian Genetical Congress held at Leningrad in January. The second and larger number begins with a paper by C. F. Rudloff giving some new results on the relation between chromosome linkage and heredity in *Œnothera*. Another article, on sugar-beet varieties, describes crosses between the wild *Beta maritima* and sugar-beets. Biographical sketches of breeders are included, as well as accounts of meetings and of institutes devoted to breeding work. The journal will no doubt serve a useful purpose in this field.

IN the Annual Report of the Department of Coal Gas and Fuel Industries of the University of Leeds, the Livesey professor, J. W. Cobb, gives an account of the activities of this Department both in teaching and research. Considerable extension of accommodation and equipment is being undertaken to meet growing needs. Of more general interest are the observations on education for the fuel industries. The National Fuel and Power Committee in 1928 reported that "the advance in the economical use of Fuel is largely dependent on a highly trained personnel". Any considerable extension of the manufacture of smokeless fuel, as popularly anticipated, will necessitate a greatly increased body of workers, not only for the preliminaries of research and experiment but also for the construction and operation of the plant. The recognition of this is, if anything, more evident in universities abroad. Even now, Prof. Cobb reports a demand for graduates which he cannot supply, and it invites comment that more young men with an aptitude for practical affairs do not fit themselves for careers awaiting them. Schoolmasters have a great influence on the decision of their pupils, but are not fully aware of the opportunities which exist, while for many the securing of 'open scholarships' exerts an irresistible attraction which has the result of diverting suitable boys from industrial careers.

"A LIST of the Original Scientific Communications by J. Reid Moir" has been published by Messrs. Harrison of Ipswich in response to requests from various quarters for a complete list of the original communications by this distinguished archæologist which have appeared in various scientific periodicals. Mr. Reid Moir, though still, as his friends and admirers will hope, far from attaining 'retiring age', has had a long and distinguished career as an archæologist; but perhaps even those who follow his work with close attention will be surprised at the length of this list, which contains no less than one hundred and forty-three items, ranging in date from 1910 to the current year. These are communications appearing in British periodicals, and do not include Mr. Reid Moir's contributions to the *Scientific American* and other publications in the United States. At the moment one entry makes a special appeal to our sympathies. It is that relating to rostro-carinate implements. It will be remembered how whole-heartedly the late Sir E. Ray Lankester threw the weight of his support into the controversy on the subject of these implements, on the side of Mr. Reid Moir, when they were first brought to the notice of the archæological world. Mr. Reid Moir himself refers to this subject in a letter on p. 373 of this issue.

A BRIEF report in the *Times* for Sept. 2 shows that the great earthquake that occurred in New Zealand on June 17 was accompanied by one feature of unusual interest. The survey of the central district made by the Public Works Department reveals great changes in the level of the land. An area about 50 miles long and 18 miles wide has been raised above its former level, the maximum uplift being 16 feet, while in 1855 the greatest elevation was not more than 9 feet. At Murchison, where most of the houses were ruined, the uplift amounted to 4 feet.

THE Medical Research Council announces that it has received from Mrs. Odo Cross a sum of £40,000 as the endowment of a trust for the establishment of research fellowships in the study of tuberculosis, to be known as the "Dorothy Temple Cross Research Fellowship Fund". The amount in question is the total sum received by Mrs. Odo Cross in respect of her daughter's estate, no part of which does Mrs. Odo Cross desire to retain for her own benefit.

THE summer issue of the *Fight against Disease*, the quarterly journal of the Research Defence Society, contains the third Stephen Paget memorial lecture, by Prof. A. V. Hill, on "Enemies of Knowledge", and the annual report of the Committee. An appeal is made for more funds which are now urgently needed to meet the demands for increased activities, as for 1928 there was a deficit of £113.

WITH the view of reducing maternal mortality in childbirth, the Ministry of Health has issued a pamphlet (Memorandum 145/M.C.W. London: H.M. Stationery Office, 1*d*. net) on "Ante-Natal Clinics: Their Conduct and Scope". The principles emphasised are that every pregnant woman should receive sufficient ante-natal care to ensure (1) that a difficult labour will be foreseen so far as can be by previous examination, (2) the early detection and treatment of toxæmia, and (3) the institution of measures against an existing infection, including venereal disease.

AN address by Prof. M. T. Bogert delivered in Philadelphia in memory of Edgar Fahs Smith, who died on May 3, 1928, appears in the issue of *Science* for May 31. It contains a full account of Smith's many contributions to knowledge in the fields of organic chemistry, inorganic, analytical and electrochemistry, and historical chemistry. Under Smith's direction, determinations of the atomic weights of eighteen elements were carried out by a variety of different methods. He was the author of a number of works on theoretical and applied chemistry, in addition to being the translator of certain well-known text-books.

WE have received the first number of a new periodical, the *Journal of the Cancer Research Committee of the*

University of Sydney (Sydney: The Australasian Medical Publishing Co., price 5*s*. per annum), which contains several papers of interest. The Commonwealth Director-General of Health, Dr. Cumpston, shows that cancer mortality in the Commonwealth is steadily rising—from about 34 per 1000 deaths in 1885 to about 94 in 1928. The cancer research fund of the University of Sydney now amounts to £134,000, of which more than £100,000 has been contributed by private subscribers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in physics at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Sept. 10). An assistant lecturer and demonstrator in the Zoology Department of the East London College—The Registrar, East London College, E.1 (Sept. 14). A woman assistant lecturer in botany in the Department of Education (Women's Division) of the University of Birmingham—The Secretary, The University, Birmingham (Sept. 18). A head of the Mining Department of the Chesterfield Technical College—The Principal, Technical College, Chesterfield (Sept. 21). An assistant lecturer in agriculture at the Seale-Hayne Agricultural College—The Bursar, Seale-Hayne Agricultural College, Newton Abbot, Devon (Sept. 21). A lecturer in botany at the University College, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 28). A professor of biochemistry at the Indian Institute of Science, Bangalore—Sir F. G. Hopkins, F.R.S., 71 Grange Road, Cambridge (Sept. 30). A lecturer in commerce in the University of Hong Kong—C.A. (N.), The Secretary, Board of Education, Whitehall, S.W.1; Scottish applications to (C.A.), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Sept. 30). A senior lecturer in economics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Oct. 1). Male junior assistants at the Chemical Warfare Research Department, London, and at the Experimental Station, Porton, Wilts—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. A sanitary inspector in the Sudan Medical Service—The Controller, Sudan Government, London Office, Buckingham Gate, S.W.1. A science master at the Day Continuation School of the Rugby College of Technology and Arts—The Organiser of Further Education in Rugby, 61 Clifton Road, Rugby. Civilian education officers in the R.A.F. Education Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1.

Our Astronomical Column.

Lembang Observatory, Java.—This observatory is of special interest from its proximity to the equator. In the list of active observatories in the *Nautical Almanac* there are only four within 10° of the equator; they are Bogota +4° 36′, Colombo +6° 54′, Lembang −6° 50′, Trivandrum +8° 31′. These observatories command a much greater extent of the heavens than those in the temperate zones. *La Nature* for Aug. 1 contains a description by Dr. A. Gradenwitz of the new equatorial which has recently been erected at Lembang. It has two objectives, each constructed by Zeiss, of 60 cm. aperture, one being designed for visual work, the other for photographic. The weight of each lens is 300 kgm., that of the whole revolving portion of the equatorial being 14,000 kgm. The focal length is 10·5 metres. The two lenses are mounted in a single cylindrical tube 1·70 metres in diameter. The diameter of the dome is 14·4 metres. Both telescope and dome are electrically driven. The article has three illustrations; two show the telescope and its mounting, the third shows a stage in the manufacture of the objectives at the Zeiss works. Two statements in the article need correction. The construction of the first reflecting telescope is ascribed to Herschel instead of to Newton, and it is stated that no double stars have been discovered by reflectors. Herschel discovered a considerable number.

Starlight.—Prof. H. N. Russell contributes a further article on this subject to the *Scientific American* for September. He quotes Prof. van Rhijn's conclusion that five-sixths of the background illumination of the sky arises from permanent auroral glow and sunlight reflected from meteoric dust. The remaining sixth is starlight; the amount received from a hemisphere is 1/600 of the light of the full moon; a certain fraction of the starlight (probably between 1/10000 and 1/1000 of the whole) comes from objects external to the galaxy. The article proceeds to speculate on the ultimate fate of the starlight in space. A considerable fraction of it is intercepted by the dark nebulæ which abound in some regions of the galaxy. These must get warmed to some degree and give out feeble radiations in their turn. The question is then raised whether matter, the annihilation or rather conversion into radiant energy of which is now generally supposed to be the maintaining power of the light and heat of the stars, is in process of being rebuilt in space. Prof. Millikan's theory is quoted that the cosmic rays which he has studied arise from the process of atom building. Prof. Russell leaves the matter open, but indicates that his own opinion is rather against such rebuilding.

Variation of the Calcium *K* Line with Distance in Early Type Stars.—Dr. O. Struve lately concluded that the strength of the *K* line in early type stars, presumed to arise from absorption in interstellar space, afforded a fairly reliable measure of the distance of the stars. In view of the importance of this conclusion, Dr. J. H. Oort has made an independent investigation which is published in *Bull. Astron. Inst. Netherlands*, vol. 5, No. 177. The distances were estimated from the proper motions. Boss's P.G.C. was used for these, but they were corrected for (1) systematic errors of proper motions in declination, (2) alteration in precession constants, (3) effect of galactic rotation. They were resolved into components towards the ant-apex and at right angles to this; the former was taken as a measure of the star's distance. The absorption coefficient is found to be about 0·00045 magnitude per parsec, a little higher than the value of Gerasimovič and Struve. A further investigation divides the stars according to galactic latitude. There is a slight tendency to greater absorption as the galactic plane is approached.

Research Items.

Culture in Polynesia.—In a monograph entitled "An Enquiry into the Question of Cultural Stability in Polynesia", which is published as Vol. 9 of the *Columbia University Contributions to Anthropology* (issued in England by the Oxford University Press, 10*s.* 6*d.* net), Miss Margaret Mead has reviewed the evidence afforded by the culture of Polynesia in its bearing on certain general questions — such as the problem of the relation of different elements in a culture, that is, the relative stability of ritual and technique, of terms of relationship and of the moiety, of the field of decoration and elements of the design, and so forth. Canoe building, house building, and tattooing were considered in five insular cultures : in Hawaii, the Marquesas, Tahiti, Samoa, and among the Maori. In the case of canoe building, it was found that variations in technique and mechanical principles were rare, but the relative importance of priest and craftsman varied enormously between the extremes in Hawaii, where the priest performed the skilled parts of the work and the builders were held in low esteem, and in Samoa, where the priest had no function and the builders were all-powerful, while in New Zealand some parts of the work was left to the chief only. The taboos also varied in extent and in degree. The extent to which the canoe entered into the religious complex was different in the different areas. In house building there was little deviation. The most definite individualisation occurred in the shape and appearance of the house, and where they were closely allied with decoration the most highly developed individualisation also was found. In tattooing the technique was even more constant, but the style was unique and specially developed in each area. The closest association appeared between Hawaii and southern New Zealand. The status of the craftsman also varied ; only in New Zealand did the priest play an important part. The content of the associated taboos and rites was different in each group. So far as the evidence carries, it would appear that technique is the more stable element, and form and decorative elements the most variable. Such data as these, therefore, would not appear valid evidence for possible culture contact between, for example, Oceania and America or Africa and Melanesia.

Line Fishing in the Moray Firth.—In continuation of his survey of the Moray Firth fisheries, Dr. A. Bowman deals with line fishing in *Fisheries, Scotland, Sci. Invest.*, 1927, II. This paper forms a review of the fishery during the period 1904–16, for which especially detailed statistics are available. Of the three methods of line fishing, small-line, great-line, and hand-line, the first mentioned is by far the most important, contributing more than 83 per cent of the total weight of all fish landed during the period. Small-line fishing is mainly a fishery for haddock, and it is most intense during the fourth and first quarters of the year when the larger categories of haddock are relatively most abundant. There is a summer-autumn feeding migration of adult haddock into the Firth from regions beyond, and a winter-spring emigration of mature fish to the offshore spawning grounds ; these movements are repeated with the greatest regularity each year. Thus, during the summer months, the small-line fishermen are dependent on the stationary population composed largely of fishes of the younger year-classes, whereas in the winter their success depends upon the magnitude of the invasion of adult fish. The annual renewal of stock by the arrival of young fish from outside is very unequal. The broods of 1904, 1909, and 1913 were exceptionally good, and dominated the catches of the larger market categories in 1907, 1912, and 1916. Accession to the stock by the progenies of the other years of the period appear to have been only moderate or poor. The effects of these alternate good and bad brood years are so marked, that over so short a period of observation they mask any progressive changes in the stock which might be due to other causes, such as fishing.

Giant Earthworms of South Gippsland.—Charles Barrett has recorded his experiences in search of these giant earthworms, *Megascolides australis* (*Victorian Naturalist*, July). They were not rare in the locality investigated, and fifty could easily have been collected from the flats near the farm, but the length of the worms and the irregular curves of the burrows make it difficult to extract a worm without damage. The burrows are generally in rich clayey flats, and in these the worms live deep down in summer, coming often to within a foot of the surface in autumn and winter. The burrows, vertical or horizontal, are always damp and slimy, and the approach of an investigator is heralded by a loud gurgling noise made by the worms as they contract in their burrows, where they can travel quickly. The eggs may lie free in loose soil, may be fixed amongst grass rootlets, and are often picked up amongst the clods in a freshly ploughed paddock. They are tough and horny, greenish in colour and translucent, oval in shape, and from two to three inches in length. The average size of the worms themselves is perhaps four feet, but six-feet examples are fairly common ; the largest Mr. Cook actually saw measured was nine feet in length, and the largest reported measured eleven feet.

Northern Hydrozoa.—Dr. Hjalmar Broch gives a good account of the Hydrozoa of the North Sea and Baltic in a recent part of "Die Tierwelt der Nord- und Ostsee" (G. Grimpe und E. Wagler. Lieferung 13, Teil III. b.c. Hydrozoa I. (Hydroida, Trachylina), Hydrozoa II. (Siphonophora). Leipzig : Akademische Verlagsgesellschaft, 1928). After a full general survey of the anatomy of the group, the author proceeds to the biology and general distribution. The bio-geographical portion of the work is interesting, certain hydroids (for example, *Eudendrium rameum* and *Hydrallmania falcata*) having a range from the laminarian zone to 2000 metres or more. Temperature is a very important factor in their distribution. In describing the feeding of polyps, the observations by Luther and Schneider are quoted, showing that *Protohydra* feeds principally on certain nematodes. It is, however, known to feed largely on copepods and oligochæts in other localities. Very little is said about the feeding of medusæ, although a good deal is known. They are exceedingly voracious and carnivorous, and their importance as devourers of larval fishes is great. A useful key is given for the identification of genera and species, the method used being excellent for quick identification. The medusa names (when known) are placed in brackets after the hydroid genus, and similarly the hydroid names after the medusæ. The order Trachylina has a chapter to itself. In it the author includes the very peculiar and aberrant genus *Halammohydra* (so far only found in the Kieler Bucht and in Heligoland), which is truly benthonic. The few Siphonophora occurring in this region belong to both cold and warm water, often appearing regularly but rarely staying for long periods.

Asiatic Species of *Corbicula*.—The Zoological Survey of India continues its invaluable series of monographs

on groups of the non-marine mollusca, the latest to appear being on the Asiatic species of the genus *Corbicula* by Dr. B. Prashad (*Mem. Indian Mus.*, vol. 9, Nos. 1-2, pp. 68, 8 pls.). On this difficult group, which, as Dr. Blanford remarked, "appears to have been designed by a beneficent Providence for the amusement of species-makers", the author has expended the same care that characterised a former paper on the Viviparidæ (see NATURE, Nov. 3, 1928, p. 712). The work of previous writers is fully discussed and criticised in the light of later knowledge and fresh material, and the list of species considerably reduced, thirty-two in all (including seven new species) being recorded and described from the region in question, which it should be noted takes in Formosa and the Philippine Islands. The half-tone plates from photographs deserve special mention since the natural coloration of the shells renders them exceptionally difficult subjects for the camera, an obstacle here most successfully overcome.

Relapse in Bird Malaria.—R. D. Manwell (*Amer. Jour. Hygiene*, vol. 9, No. 2, March 1929) records observations on relapse in bird malaria, based on the study of about 180 birds. Relapse was studied most thoroughly in the case of chronic infections with *Plasmodium cathemerium*, which is the most convenient strain for experimental work, but three other series of birds infected with *P. præcox*, *P. inconstans*, and the Whitmore strain of the latter have also been used. Both short-term and long-term relapses occur in bird malaria as in human malaria; the short-term relapses appear to be more common and usually more dangerous to the bird. A seasonal variation in the relapse rate occurs, the greatest number of relapses being noted in the autumn and winter and the smallest number in summer. The four strains differed in their liability to relapse; the Whitmore strain relapsed in 61 per cent of the cases, *P. præcox* in 36·5 per cent, *P. inconstans* in 25·8 per cent, and *P. cathemerium* in 5·5 per cent. The susceptibility of individual birds to relapse varied; for example, 60 per cent of the birds infected with *P. cathemerium* did not relapse, and most of the relapses recorded for this species of malaria occurred in 20 per cent of the birds. Some birds relapsed eight or ten times. There is no evidence that the severity of the original infection has anything to do with the liability to relapse. If complete recovery, in the sense of absence of parasites, ever occurs naturally, it is very rare; prolonged absence of the parasites from the peripheral blood, as judged by ordinary methods of examination, cannot be regarded as any indication of such recovery. The part played by environmental factors in bringing about relapse is problematical. A useful summary of the investigations on bird malaria which have been carried out at the Johns Hopkins School of Hygiene during the last ten years is given by Prof. Robert Hegner in the *Quarterly Review of Biology* (March 1929).

Preserved Potatoes.—Potatoes are an important crop in Holland, being cultivated for two distinct objects, namely, human consumption and industrial purposes. Different varieties are grown according to the use for which they are intended. Unlike grain crops, potatoes cannot be stored for use in the following year, so that the farmer who is situated at a distance from a co-operative meal factory is apt to lose a good deal through wastage. This is particularly the case in seasons of exceptionally high yield, or if, owing to disease, the natural keeping qualities of the crop are impaired. A method of preserving surplus eating potatoes for feeding to stock, employed by the Dutch farmer, is described by J. Dunlop in *Scottish Journal of Agriculture*, **12**, p. 318. The potatoes are first washed and then steamed in as little water as possible. After pouring off the liquid the tubers are packed closely and firmly into a pit about 3 ft. deep in the ground. Old jute bags are laid over the potatoes, which are then covered with a foot of soil. In wet climates the pit is thatched over with straw. With proper packing all air is excluded and the potatoes keep in good condition for years. Salt is needed before feeding the tubers if it was not added during the process of steaming. The total cost of labour and fuel is calculated at about 2*s.* per ton, and as the feeding value and flavour of the potatoes undergo but little depreciation during either steaming or storage, the saving effected is considerable.

Preservation of Fossils.—The *Naturalist* for April, May, and June 1929 contains a valuable paper by E. G. Radley on "The Preservation of Pyritised and other Fossils". The cause of the disintegration and destruction of pyritised and phosphatised fossils is the action of oxygen in the presence of water, whereby sulphates of calcium and iron are formed. A series of experiments suggests that either pyrites or marcasite (or both) are disseminated throughout the specimens in an extremely fine state of division. If the particles within the mass are already in course of conversion to sulphate, it is not possible to save the fossils from complete destruction. If, however, the damage be slight, preservation can be successfully achieved by removal of the superficial white decomposition products, through washing and drying, followed by a coating of the specimen with celluloid varnish or preferably 'dope'. The latter is a nitrocellulose with amyl acetate and alcohol. It may be sprayed over the specimen, or poured over and worked in with a brush. Dilute solutions of 'dope' are sold under the name of 'invisible lacquer', but if this be used it is advisable to give two or three coats. Of all the media used as protective coverings for pyritised fossils, 'dope' has been found to be not only the most resistant to noxious gases, but also sufficiently elastic to withstand the contraction and expansion due to changes of temperature.

Frost Heaving.—A series of experiments have been carried out by Stephen Taber to determine the factors involved in the uplift of surface soil that takes place when the soil water freezes. The results are recorded and discussed in the *Journal of Geology*, July–August 1929. Freezing of soils often results in heaving to a greater degree than can be attributed to the change in volume of the water present. This excessive heaving is due to the upward segregation of water as it freezes near the surface, the additional water being drawn in by molecular cohesion. Pressure effects result from the growth of ice crystals, the direction of growth being determined chiefly by the direction of heat conduction and the availability of further supplies of water. In the experiments, pressures of more than 14 kgm. per sq. cm. were obtained through the growth of ice crystals to form segregated layers. Segregation occurs readily if the grade size of the particles is less than a micron. It is also favoured by a high water content, and very thick ice layers may develop where water can be drawn up from the water-table. Where the soil is very impermeable because of a high colloid content, shrinkage cracks appear and are gradually filled and enlarged by ice. The principles revealed by the investigation help to explain such geological phenomena as buried sheets and lenses of ice and soil-polygons with convex surface; they also suggest applications to engineering, as in the construction of hard-surfaced roads.

Atmospheric Electricity.—We learn from *World Power* for August that progress has been made in the experiments with atmospheric electricity now being carried out by the Physical Institute of the University of Berlin at Monte Generoso, near Lugano. Unfortunately, one of the three physicists engaged in the tests—Mr. Urban—was accidentally killed by falling from an antenna. The other two, Messrs. Brasch and Lange, are continuing the research. The early experiments were made with a network of wires suspended by strings of high tension insulators from two mountain peaks, the minimum height above the ground being eighty metres. The voltage obtained between the network and the earth when sufficiently high was measured in the ordinary way by an air-gap between spherical electrodes. The width of the air-gap was adjusted by an operator from an adjacent metal-sheathed hut. During the first year, the network once remained highly charged with electricity for about thirty minutes. Unluckily, sparks kept occurring across the air-gap when it was extended to its maximum width of four and a half metres. The voltage was obviously greater than that required to bridge this gap. It was estimated as being about four million volts. The following year (1928) the insulation resistance of the net of overhead wires was greatly improved. It was suspended by double chains, each consisting of 175 insulators in series and each weighing more than two tons. These, however, were finally replaced by seventy metre lengths of impregnated hemp ropes in series with insulators. These gave a long leakage path, high resistance to puncture, and ample mechanical strength. The spark gap was also replaced by the gap between an arrangement of two parallel wires. Discharges eighteen metres long were obtained, but the maximum pressure could not be measured as a wide enough air-gap could not be obtained. It was computed to be more than ten million volts. Simultaneously with the research work, useful commercial work at high voltages is being carried out.

Capture of Electrons by α-Particles.—Some very interesting results for the neutralisation of α-particles are reported by Prof. Bergen Davis and Mr. A. H. Barnes in a preliminary paper in the first July number of the *Physical Review*, which is now being issued twice monthly. Parallel beams of electrons and α-particles were passed through an exhausted vessel, and the final composition of the beam examined by analysis in a magnetic field. The number of α-particles which were partly neutralised was found to vary in a remarkable way with the relative velocities of the α-particles and electrons, and it appears that capture of an electron by an α-particle does not occur unless the electron, as seen from the α-particle, has almost the exact speed which it would possess in one of the circular quantised orbits of singly ionised helium. The curve showing the percentage of captures against the energy of the electrons is composed entirely of sharp peaks, one of which corresponds to zero relative velocity of the particles, and the others to capture in orbits with quantum numbers between one and eleven. This work raises important theoretical questions, and both the experimental methods and the interpretation put upon the results will no doubt be subjected to a searching scrutiny when they are published in detail.

Chlorides of Sulphur.—The *Journal of the Chemical Society* for July contains an interesting communication from Prof. T. M. Lowry and G. Jessop on the optical properties of liquids containing sulphur monochloride (S_2Cl_2) and chlorine. A previous investigation by the freezing-point method, published in 1927, showed that sulphur dichloride, SCl_2, has a definite range of stability and can be frozen out as a crystalline solid from a liquid of suitable composition. A new chloride, S_3Cl_4, in addition to the previously known SCl_4, was also indicated on the freezing-point diagrams. There is no maximum at the composition of SCl_2, as the compound dissociates as it melts. The present experiments, based on a study of molecular extinction coefficients, show that whilst SCl_4 is the stable solid phase from 65 to 100 atoms per cent of chlorine, it is almost non-existent in the liquid state. The garnet-red liquid produced by chlorinating sulphur monochloride consists almost entirely of the monochloride and dichloride. The usual opinion that the liquid dichloride is a mixture of tetrachloride and monochloride is shown to be incorrect. The liquid dichloride is dissociated to the extent of about 16 per cent at atmospheric temperature: $2SCl_2 \rightleftharpoons S_2Cl_2 + Cl_2$.

A Qualitative Reagent for Sodium.—The difficulty of obtaining positive evidence for the presence of sodium in qualitative analysis is well known, and the description, by E. R. Caley in the July number of the *Journal of the American Chemical Society*, of a new reagent which precipitates sodium is therefore of interest. The reagent is made as follows: One solution is prepared from 40 gm. crystallised uranyl acetate, 30 gm. glacial acetic acid and water to 500 c.c., and a second solution from 200 gm. crystallised cobalt acetate, 30 gm. glacial acetic acid and water to 500 c.c. Each solution is separately warmed to 75° until all is in solution; then they are mixed at this temperature and allowed to cool to 20°, being kept at this temperature for an hour. The reagent is then filtered through a dry filter into a dry bottle. It keeps indefinitely. The sodium solution should be as concentrated as possible, and to 2 c.c. of it are added 10-20 c.c. of the reagent. The test-tube is stoppered, shaken vigorously for two or three minutes, and allowed to stand at least five minutes. A yellow precipitate indicates sodium. In qualitative analysis the filtrate from Group IV. (alkaline earths) is acidified with dilute sulphuric acid, evaporated, the ammonium salts fumed off and the residue dissolved in 2 c.c. of water. One portion is tested for potassium with cobaltinitrite and the other for sodium as described. Two milligrams of sodium give an immediate precipitate, one milligram after standing an hour or two.

Steam Turbine Progress.—In a paper read at Johannesburg on July 31 before Section G (Engineering) of the British Association, and published in *Engineering*, Aug. 16, Sir Charles Parsons referred to the growth in size of turbo-alternators and to modern developments in steam turbines. The first turbo-alternators in South Africa were three 135-k.w. sets supplied to a company at Cape Town in 1901; the largest sets to-day are the four 20,000 k.w. machines at the Witbank Power Station. A 30,000 k.w. unit is under consideration for Vereeniging. Recent developments leading to increased fuel economy and output per unit include higher steam pressures and temperatures, regenerative heating of the feed water, the use of air preheaters and economisers, reheating of the steam after partial expansion, improvements in surface-condenser design, and new methods of winding stator conductors. New methods have also been introduced for producing sound ingots for the turbine shafts and alternator rotors. Development in marine work is indicated by the fact that there are now built or building mercantile installations of about 500,000 total horse-power, with boiler pressures ranging from 350 lb. to 550 lb. and steam temperatures of 700° F., and more than 650,000 h.p. for war vessels, with steam pressures ranging from 325 lb. to 500 lb. and steam temperatures of 600°-750° F.

The Zimbabwe Ruins.

FURTHER details of Miss Caton-Thompson's excavations in Rhodesia on behalf of the British Association have now reached England by mail. They confirm the brief outline of her results conveyed by cable. The detailed evidence contained in the report presented to Section H (Anthropology) when the Association met at Johannesburg may be taken to place the question of the origin and dating of the Zimbabwe ruins beyond dispute. Miss Caton-Thompson's report was presented to a crowded audience, among whom was the president of the Association, Sir Thomas Holland, and not only was it necessary that it should be relayed, but also the lecture had to be repeated afterwards at an evening meeting.

Miss Caton-Thompson's conclusion as to the relatively modern date and native origin of these ruins in no way detracts from the wonder with which we cannot but regard this remarkable assemblage of structures. Indeed it must heighten it, for although she finds the technical skill displayed and the structural perfection somewhat less than has sometimes been asserted, the extent and character of the ruins still point to an ability and a capacity for organisation on a large scale which are justly considered remarkable in an indigenous people.

Miss Caton-Thompson came to the investigation of the Zimbabwe ruins with great advantages. Apart from her experience as an excavator, she had the results of many previous investigators, including Bent and Randall-MacIver, before her. The excavations of Randall-MacIver, made twenty-four years ago, were peculiarly important, as they were the only investigations made by a competent trained archæologist. Miss Caton-Thompson, therefore, felt herself justified in accepting his facts, while ignoring his conclusions, in carrying out her own investigations. It may, however, be borne in mind that Randall-MacIver had found medieval objects, especially Chinese porcelain, and pottery, iron, and other objects of native origin in strata which were contemporary with the buildings. In particular, he found that such objects were contemporary with and an integral part in time of the cement floor upon which R. N. Hall, by whom he was most strenuously attacked, had relied for his evidence of an earlier date. Randall-MacIver's conclusion, therefore, was that the ruins were medieval. Conclusive as was the argument to anyone trained in archæological methods, it did not obtain general acceptance in South Africa. It was maintained that the investigation was hurried and not sufficiently wide in scope, that evidence had been misinterpreted, and that Randall-MacIver's knowledge of indigenous culture was not adequate to enable him to pronounce a judgment. It is to be noted that he is completely vindicated by Miss Caton-Thompson's results.

In one respect the present investigation was hampered by previous work. Enthusiastic amateurs had attacked most of the best sites, and Miss Caton-Thompson was for a time at a loss as to which site would serve her purpose. Her main object, as defined by herself, was to check the exact relationship of the lowest occupation layers beneath the original cement floors to the main walls of the Elliptical Temple at Great Zimbabwe. It was therefore necessary to choose a site unquestionably as old as the Elliptical Temple of Great Zimbabwe, and also a site which showed an intact cement floor. On such a site it should have been possible to demonstrate whether the walls were contemporary with a pre-medieval level. As neither the well-known ruins at Dhlo-Dhlo nor Great Zimbabwe itself complied with both these conditions, the Maund buildings in the Valley of Great Zimbabwe were selected. Though in ruins, the walls showed all the characteristics of Great Zimbabwe, and were held to belong to the oldest group.

A trench was dug from wall to wall to test the stratification. It was found that beneath a thin skin of humus was ten inches to a foot of hard cement formed of pulverised granite, which in turn overlay 2 ft. 6 in.–3 ft. of a brown-red soil of natural origin—hill wash—containing charcoal, sherds, iron slag, etc. Upon this the walls were actually built, and this was found to be the case, except in one instance, with every one of the 29 segments of wall in the ruins. This occupation layer rested upon virgin soil, and as the walls were built upon it, it afforded exactly the evidence which was sought.

Of the material found *in situ*—as much *in situ*, as Miss Caton-Thompson put it, as "any ever will be this side of heaven"—there were 448 potsherds in small fragments, of which 40 were rims. Four hundred and eighteen were in coarse red-brown ware, gritty, with quartz particles, from which the slip, or other surface, had disappeared owing to damp. There was also a small class of plain black polished ware, indistinguishable from that found through the higher levels. Ware similar to the coarse red-brown ware was found by Dr. Randall-MacIver at Niekerk, near Umtali—ruins which he judged to be rather older than Zimbabwe.

A certain amount of iron was found and lumps of iron slag were distributed throughout; no smelting furnace was found. There were also a small number of iron weapons and an axe head from this pre-wall stratum. A few fragments of bangles of flat bronze wire coiled over grass fibre were also discovered of a type familiar at all levels in the Rhodesian ruins. It was pointed out by Miss Caton-Thompson that at this stage none of these objects is dateable, but they are typically Bantu in character.

A series of pavements of granite slabs about 4 inches thick and forming causeways about 2 feet wide, were found resting on the virgin soil, and in one place running under the foundations of the entrance. Pottery and slag were found actually in contact with this pavement, but, it was concluded, it afforded no evidence of occupation prior to the building, but was a pavement laid down for convenience, exactly similar to the device employed by natives to-day preparatory to building.

Up to this point, no article not of native manufacture had been found. Attention was now turned to Great Zimbabwe and in the first place to the middens. It was found that at a depth of about 12 ft. 6 in., clay passed into black midden with quantities of split animal bones, especially ox, of no very ancient aspect; between 13 ft. 6 in. and 15 ft. came two pots of undecorated native ware, six pottery phalli, and fragments of bronze wire bangles, and at 18 ft. on rock bottom were two more pots of ordinary Bantu type, to be paralleled from any Rhodesian ruins. In another similar investigation a curious stone structure was encountered, and beneath it, from under a pavement of granite slabs at from 15 ft. to 17 ft. beneath the surface, were found three fragments of iron tools, iron slag, a white porcelain bead on copper wire, and 80 other beads in coloured opaque glass, this at a level five times as deep as the finds at Maund. They therefore represent the earliest period of debris of the Zimbabwe "Acropolis".

Extensive work in the neighbourhood of the

Elliptical Temple produced strictly comparable results. The Conical Tower of Zimbabwe was also attacked with the consent of the Rhodesian Government; a tunnel was driven through from side to side, exposing a width of 3 ft. to 4 ft. to bed rock. It was found to rest without any preparation whatsoever on 6 ft. 6 in. of sandy yellow subsoil similar to that under the Maund ruins. The first find was a beautiful early stone implement. The soil was sieved, but all that it produced was a small iron band, a minute gold bead, traces of wire bangle, and a small sherd of the usual black polished pottery. The workmanship is haphazard, the foundations have not been levelled, and fence to counteract a fall of 1·9 ft. in a diameter of 18 ft. 4 in., the upper courses have had to be thickened.

As regards dating, a larger number of beads has been obtained than ever before, possibly owing to the use of the sieve. Although a full report on them has not yet been received, they include types from southern India, definitely considered to be not later than A.D. 900. Others are found in ruins of villages in Malaya and Borneo, and are assigned to a period between A.D. 600 and A.D. 1100. Dr. Randall-MacIver's evidence from objects of foreign origin gave comparable dates ranging to the sixteenth century. The evidence of the two investigations may be regarded as complementary; one fully substantiates the other. As to the Semitic origin of the ruins, there can be no question, in Miss Caton-Thompson's view, that they are typically Bantu. This, however, does not eliminate their interest. As the author said in the remarks with which she concluded her report: "Instead of a degenerate offshoot of a higher Oriental civilisation best studied in its homeland, you have, I believe, a vigorous native civilisation, unsuspected by all but a few students, showing national organisation of a high kind, originality, and amazing industry. It is a subject worthy of all the research South Africa can give to it; South African students must be bred to pursue it."

The Chilean Earthquake of 1922.

IN studying the great Chilean earthquake of Nov. 10, 1922, Prof. Bailey Willis has been led to some interesting conclusions with regard to the origin of the great earthquakes of Chile and Peru. Invited by the Carnegie Institution to study the earthquake, he spent seven months in Chile, five of them in the province of Atacama, in which the earthquake attained its greatest strength. The results of his work are described in a volume of unusual interest and value.[1]

The northern part of Chile consists of the desert region of Atacama. In climate and topography it closely resembles southern California. It is a region of interior basins, of salt plains and sterile mountains, one of the most arid districts of the world. Both countries are similarly situated with regard to the deep ocean basin of the Pacific and the high cordilleras to the east. In Chile, however, there is no great longitudinal river system as there is in California. The rivers flow from the Andes direct to the sea in channels that are in places divided by mountain ranges of considerable altitude.

In the last four centuries, from 1543 until 1922, the province of Atacama has been visited by 22 destructive earthquakes, the last but one, on Dec. 4, 1918, especially strong at Copiapó. During the month preceding the earthquake of 1922, from Oct. 4 until Nov. 8, there was general activity throughout the entire length (1500 miles) of the earthquake zone of Chile and south Peru, no fewer than eight earthquakes of unusual strength, though of limited incidence, having occurred within it. Then came the great earthquake at about 11.45 P.M. on Nov. 10 (4h. 32m. 33s., A.M., Nov. 11. G.M.T.).

The earthquake was remarkable more for the extent of its area of disturbance than for its intensity at any point within it. From some rough estimates made by Prof. Willis, it would seem that the maximum acceleration was about 3000 mm. per sec. per sec., and it nowhere attained so high a value as 4800 mm. per sec. per sec. In other words, the shock was about as strong as that of the Japanese earthquake of Sept. 1, 1923. But while the disturbed area of that earthquake does not appear to have exceeded 166,000 square miles, the Chilean earthquake was violent over a zone not less than 300 miles in length, from La Serena to Potrerillo; it was fairly strong within an area reaching from Iquique to Concepcion (1250 miles); it was readily perceptible over an area of about two million square miles, including Buenos Aires to the east and the island of San Felix to the west. A disturbed area so extensive points, of course, to an unusual depth of origin.

Within the central area there were wide and rapid variations of intensity, the destruction, as usual, being greatest on marshy ground and least on rocky spurs. But part of the irregularity was also due to the occurrence of fault-lines, along which the shock was most violent, possibly from the occurrence of secondary shocks. It was found impossible to draw isoseismal lines, not only because records of intensity were scanty, but also because there was no central region surrounded by zones of decreasing strength. Copiapó and Vallenar, for example, are 87 miles apart and they are built on similar subsoils. At both places the intensity was very great and approximately the same, while between them are villages, built of essentially the same materials, that suffered little or no damage.

In California, the earthquake-faults are vertical planes. The movements that have given rise to earthquakes are partly upwards and partly horizontal, but while the total uplifts are to be measured in hundreds of feet, the horizontal shifts are to be reckoned in miles. In Chile, Prof. Willis could find no proof of the existence of such faults. He therefore supposed, as Mr. R. D. Oldham had supposed thirty years before,[2] that the earthquake might be connected with a compound structure consisting of a great major thrust at a depth of some miles with minor thrust-planes running up to the surface. In his search for such a structure, he found that the whole district from La Serena to Potrerillo is a zone of minor thrust-faults, fourteen of which were found to run nearly parallel to one another at distances of from 2½ to 12 miles apart. The total width of the faulted zone in the latitude of Copiapó is about 100 miles, but the zone may extend westwards beneath the ocean and eastwards among the mountains. The outcrop of the great major thrust was not seen by Prof. Willis, but its existence has been recognised by other geologists along the eastern base of the Andes.

Prof. Willis thus concludes that the earthquakes of Chile are of tectonic origin and are independent of

[1] "Studies in Comparative Seismology: Earthquake Conditions in Chile." By Bailey Willis. With Contributions by J. B. Macelwane, Perry Byerly, Johannes Felsch, and H. S. Washington. (Publication No. 382.) Pp. xi+178+75 plates. (Washington, D.C.: Carnegie Institution, 1929.) 5.50 dollars.

[2] India, *Geol. Surv. Mem.*, vol. 29, 1899, pp. 164-179.

volcanoes. They are due, he thinks, to extensive movements along a major thrust or thrusts, which originate beneath the Pacific Ocean basin and rise gently to their outcrop. These surfaces of rupture are of vast extent; it is possible that their area may amount to hundreds of thousands of square miles. There may also have been movements along the minor thrust-faults, for the shock was strongly felt at many places along their outcrops, but, so far as Prof. Willis was able to observe, there do not seem to have been any displacements left visible at the surface.

C. DAVISON.

Dibranchiate Cephalopods of Japanese Waters.[1]

A STUDY of the late Dr. Sasaki's monograph is a sufficient reminder that the death of this accomplished specialist was a serious loss to systematic zoology. The writer of this review wishes to take the opportunity of expressing his feeling of personal loss and his appreciation of Dr. Sasaki's courtesy and kindness.

This monograph is devoted to the cephalopods of Japan and the area between Bering Straits and the Bonin Islands and Formosa. It embodies the results of a study of no less than 10,000 specimens, which must be the largest collection of cephalopods ever handled by a single investigator. The cephalopods of Japan have been studied in the past by able systematists such as Appellöf, Wülker, and Stillman Berry. We have, however, for a long time required a critical study of this fauna.

The chief importance of Dr. Sasaki's work lies in the fact that it provides this intensive and critical study. The author deals with 125 species referable to 52 genera. Each species is very exhaustively described, and the author does not confine his attentions to the external parts, 'gladii', etc., which have been usually the principal objects of taxonomic study. In many instances he describes internal structures (radula and reproductive organs) which have been too often neglected. He supplies valuable tables of measurements by which the variation of the species may be assessed, and the copious and admirably clear text-figures are a noteworthy feature of the volume. This is work of a kind that is always needed and is perhaps too little forthcoming in the study of a group like the cephalopods. Concurrently with the output of descriptions of new species, etc., we require a constant critical taxonomic revision, a deeper exploration of anatomical features and a fuller analysis of variation, in order that our genera and species may as nearly as possible reflect the divergences in the natural populations from which our material is abstracted.

In his treatment of the broad outlines of classification, Dr. Sasaki does not depart from the lines laid down by earlier workers, and one could have wished that he had discussed decapod phylogeny and classification to some extent. He does not accept Naef's threefold division of the Decapoda, but retains the older and unsatisfactory Myopsida and Egopsida. He divides the Octopoda into Pinnata and Apinna, which are exactly equivalent to Grimpe's earlier Cirrata and Incirrata. Sasaki's names, however, may eventually prove more appropriate, as Berry's *Lætmoteuthis* (in most respects a 'cirrate' form) seems to be devoid of cirrhi.

Sasaki's amplified account of the rare octopod *Watasella* is a very welcome addition to our knowledge of an interesting group intermediate between the Decapoda and Octopoda. He does not, however, discuss the highly important question as to whether the 'filaments' of *Watasella* are homologous with the arms. Finally, he makes valuable additions to our knowledge of the structure and classification of the Pacific octopods, though it is a pity that by an inadvertence which, had he been able to correct the proofs, he would doubtless have remedied, he includes in his definition of *Polypus* (=*Octopus*) "Nor (*sic*) cartilaginous stylets present internally". The "cartilaginous" (chitinous) stylets of *Octopus*, last vestige of the shell, have been figured in several species.

G. C. R.

[1] *Journal of the Faculty of Agriculture*, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Supplementary No.: "A Monograph of the Dibranchiate Cephalopods of the Japanese and adjacent Waters". By Madoka Sasaki. Pp. v+357+30 plates. Tokyo: Maruzen Co., Ltd., 1929.

Copals and Damars.

AT a recent meeting of the Royal Society of Arts an interesting paper on East Indian copals and damars was presented by Mr. A. F. Suter, which has appeared in *Jour. Roy. Soc. Arts*, vol. 77, April 19. The distribution of resiniferous plants is world-wide. Of the resins known to commerce the two chief groups are the copals and the damars. This division of the major resins is somewhat arbitrary, being based upon the difference of their physical characteristics, but is, however, quite a useful one.

There are eight commercial copals, their names indicating the country of origin, namely: Macassar or Manilla, Kauri, Congo, Zanzibar or Lindi, Mozambique or Inhambane, Sierra Leone, Angola (Benguela), and Demerara. The first two are obtained from species of *Coniferæ* (*Agathis*), whilst all the others come from leguminous species of trees. The damar-producing trees all belong, so far as present known, to the order *Dipterocarpaceæ*. They are largely collected in the Federated Malay States, Sumatra, and Borneo.

Considerable confusion has existed in the past on the subject of copals and damars. Mr. Suter states that the name copal, which is the Mexican for resin, is unknown in the East, where both copals and damars are known as damar, the Malay name for resin or a torch made of resin. In Europe, in the trade, both groups have been erroneously called gums, on account of their physical similarity to true gums. The author's paper mainly concerns copals, and deals chiefly with Macassar or Manilla copal which is obtained from *Agathis alba*, where it occurs most commonly in the Dutch East Indies; the tree is also found in the Celebes, the Moluccas, Borneo, Sumatra, and New Guinea. It is also present in the Philippines, where it is exploited, and in the Federated Malay States, where the resin is not as yet collected. The *Agathis* has characteristics in common with the Araucaria, and Mr. Suter deals at length with the tree and its habitat, the nature of the resin, and the methods of tapping the trees.

The various types of Macassar copal known in the trade are (*a*) hard or fossil copal, of unknown but often very great age, and very hard, (*b*) half-hard copal less hard and much younger, (*c*) soft or spirit-soluble copal. The first is found either in the crotches of branches in old trees or else dug from the ground under old trees or where trees at one time existed; the other two are of recent origin, and are obtained by tapping the trees. Mr. Suter directed attention to the very efficient Dutch Forestry Department, which has studied the copal business and industry with great thoroughness.

University and Educational Intelligence.

THE thirteenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation of New York. It is in the same form as previous issues and is entirely devoted to a description of the various medical departments of the Vanderbilt University School of Medicine, Nashville, Tennessee.

A SERIES of lectures during the Michaelmas and Lent terms on general science—or better, perhaps, on aspects of modern scientific thought—has been arranged by University College, Cardiff. The lectures, by various members of the staff of the College, are delivered on Saturday mornings at noon, beginning on Oct. 5. The lectures are not free, but are open to members of the public.

OF sixty-eight doctorates the conferment of which was notified in the *London University Gazette* of July 31, thirty-seven were in the faculty of science, as follows: ten in chemistry, five in botany, three in bacteriology, two each in anthropology, biochemistry, geology, psychology, and zoology, and one each in agricultural chemistry, chemical technology, economics, education, physics, physiology, and statistics. Of the recipients of these degrees thirteen were students of the Imperial College of Science and Technology, nine of University College, and four of King's College. Of fifty-nine Ph.D. degrees, thirty were in the faculty of science, sixteen in arts, eight in economics, and five in engineering. This distribution of doctorates among the various branches of science may be compared with the following distribution of American university doctorates in 1927–28: chemistry 269, zoology 89, physics 78, psychology 66, botany 61, mathematics 44, geology 35, agriculture 31, pathology 31, bacteriology 29, engineering 28, physiology 28, other subjects 44.

AT the world conference on 'New Education' held at Elsinore, Denmark, during August under the auspices of the New Education Fellowship, reports on examinations were submitted to the Examinations Enquiry Committee from 22 different countries. Dissatisfaction with the examination systems as conducted in their respective countries was generally expressed by the delegates. Among the principles adopted by the Committee were the following: Scientific inquiry into the examination system is necessary, possibly on the lines of that started in England by the New Education Fellowship in co-operation with teachers' organisations. A rigid mechanistic type of external examining and supervision interferes seriously with good teaching. Teachers should take an active part, both as individuals and in their corporate capacity, in examination procedure and reform. In any inquiry undertaken there must be consideration of (1) a newer philosophy and method in education; (2) the expanding programme of publicly supported education; (3) the changing curriculum; (4) the more recent developments in psychology, particularly available evidence on the emotional effects of the present examination system; (5) the practical experience in pioneer schools in different countries; (6) the scientific measurement movement with its efforts on behalf of new-type examinations. As to examinations for entrance to universities and higher technical institutions, it will undoubtedly be necessary to devise more adequate methods of selection. The authorities should give careful consideration to the desirability of taking into account various measures of the candidate's ability to profit by university study, such as the judgment of the teachers and the record of school work. Experiments that have been made in practically unrestricted admission to university study in several countries should also be examined.

Calendar of Patent Records.

September 8, 1832.—The patent granted on Sept. 8, 1832, to Richard Badnall for his new system of railway in which great economy of working was to be obtained by running the trains on an undulating track having long descents and comparatively short ascents, aroused a lengthy discussion, sponsors and opponents of the scheme having a battle royal in the pages of the *Mechanics' Magazine* and other journals throughout the years 1833 and 1834. Experiments were actually carried out on a section of the Liverpool and Manchester Railway with Stephenson's *Rocket* and other locomotives, but proposals for further trials of the system were abandoned.

September 9, 1829.—T. S. Brandreth's patent, dated Sept. 9, 1829, for "a new method or methods of applying animal motion to machinery" covers the invention of his 'cyclopede' locomotive which ran during the celebrated Rainhill locomotive trials, the centenary of which occurs next month. The 'cyclopede' was worked by two horses moving an endless platform with their feet, and at the trials, with a gross weight of about 5 tons, travelled with its load at 5 miles per hour. The horses themselves actually walked at the rate of 1¼ miles an hour.

On the same day, Sept. 9, 1829, there was granted to James Soames a patent for the separation of coconut oil into its solid and liquid constituents, which laid the foundation of the present-day firm of Price's Patent Candle Co., Ltd. The patent was purchased in 1830 by Edward Price and Co. for the purpose of using the coconut stearin as a substitute for tallow in the production of a cheap candle. The use of the material itself did not prove satisfactory, but a half-and-half mixture with tallow was more successful, and the 'composite candle' put on the market for the first time in 1840 was immediately popular. The patent was extended for three years from 1843, and the business was acquired by the present company four years later.

September 10, 1856.—Sir William Siemens' application for a patent on Sept. 10, 1856, included a provisional specification in which was described for the first time a 'drum-wound' armature of the kind afterwards used in the Siemens' dynamo, as suggested to him by his brother Werner. The application was not proceeded with, and the patent was not granted.

September 11, 1828.—One of the most important improvements in metallurgy was the introduction of the hot-blast in iron-smelting, which was patented by James Beaumont Neilson on Sept. 11, 1828, and was first demonstrated at the Clyde Ironworks in Glasgow the following year. The actual invention of the use of the hot-blast has been with some reason attributed to Robert Stirling, who describes its use for the purpose of economising fuel in glass furnaces in his patent of 1816, but prior to Neilson's patent there was no commercial application to the making of iron. In fact, the iron-masters had been convinced of the superiority of the cold-blast because the furnaces were known to have a greater production in winter than in summer. Neilson's rights were hotly contested, but the litigation, which came to an end only in 1843, resulted in Neilson's favour.

September 11, 1876.—The Jablochkoff 'electric candle', one of the earliest successful arc lamps, was the subject of a patent application made on Sept. 11, 1876. The application was not completed, but a patent was sealed on a second one made a few months later. The lamp, which for a time was extensively used, comprised two parallel carbons cemented together and insulated one from the other by a mass of kaolin, and required a 'bridge' to start it.

Societies and Academies.

CAPE TOWN.

Royal Society of South Africa, June 19.—**Sir Thomas Muir**: The literature of Cayleyan matrices.—**A. Ogg**: The space group and symmetry of potassium, ammonium, and rubidium sulphates. Taylor and Boyer have confirmed the space group for ammonium and cæsium sulphates, and have given an atomic structure which is substantially the same as that given by the author. The space group V_h13 given by F. P. Goeder for potassium, rubidium, and cæsium sulphates is untenable; the space group is V_h16, as originally determined by the author and confirmed by Taylor and Boyer.—**W. Pugh**: Germanium dioxide in aqueous solution; germanic acid. Germanium hydroxide is truly amphoteric. As an acid, it forms the more characteristic series of salts, the germanates; as a base, it forms the less stable series of salts with the halogen acids. Electrometric titrations of sodium germanate solutions show that germanic acid is a dibasic acid; the existence of sodium bi-germanate in solution has been established. The degree of hydrolysis of sodium germanate has also been measured at various dilutions.

GENEVA.

Society of Physics and Natural History, June 20.—**H. Lagotala**: The geology of the region comprised between the Combabet and the eastern Luvisi. The author has recognised in this region, between the sandstone grit plateaux of Tchicoumba and Cataractes, a system of folds and fractures presenting two orientations. The limestone-schist series underlying the grit is strongly folded on the edge of the grit plateaux; in the interval between the two plateaux it is undulated. Under the grits this series is much more even.—**M. Gysin**: The geological profile of Mount Passa at the Cataractes plateau. The author has made a petrographical study of different varieties of conglomerate grits, of siliceous limestones, and of foliated limestones. He distinguishes two conglomerates, one in the grits and near their base, the other between the limestones and the grits. His observations confirm, on broad lines, the observations of Delhaye and Sluys.—**R. Berner**: The magnitude of a force which tends to displace the continents towards the west. The author sets out to control by calculation the hypothesis of Wettstein on the retarding action exercised by the lunar-solar attraction on the terrestrial crust relatively to its viscous substratum. The ratio of this force acting on an element of continent to the terrestrial attraction exercised on this same element is $\frac{1}{33 \times 10^9}$, a negligible quantity. Hence this force cannot be a cause of displacement of the continents to the west.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 11).—**V. Mitkevič**: Anomalous magnetic flux of a toroidal coil (2). The case of an unclosed screen. The author has succeeded in separating the anomalous magnetic flux and in establishing its existence; he has also found some conditions in which the anomalous magnetic flux arises in the form of free magnetic rings.—**N. I. Vavilov**: Geographical localisation of genera of wheat. The principal world centre of forms of cultivated wheats proved to be in Abyssinia, where as many as two hundred varieties of *Triticum durum* and *T. turgidum* and more than sixty varieties of *T. polonicum*, *T. dicoccum* and *T. vulgare* have been found. The second centre of wheat varieties is in the restricted area at the southern foothills of the eastern Hindu Kush and of the western Himalayas.—**M. K. Serebrennikov**: Review of the beavers of the Palearctic region. Five subspecies of *Castor fiber* L. are recognised by the author, namely *C. fiber fiber* L., in Sweden; *C. f. elbicus* Matschie in Central Europe; *C. f. vistlans* Matschie, in the basin of the Vistula and the Dnieper; *C. f. pohlei* sbsp., in the Ural mountains; and *C. f. birulai*, sbsp. in the Mongolian Altai.—**A. M. Djakonov**: New starfishes from the Okhotsk Sea. (2). *Leptasterias orientalis*, sp. n.

Comptes rendus, No. 12.—**N. M. Kryloff** and **N. N. Bogoliubov**. The approximate solution of the problem of Dirichlet.—**V. Mitkevič**: Total electromotive force of mutual induction.—**A. G. Frank-Kamenecki** and **N. M. Vaksberg**. The mineral spring of Gonzha in the Amur region. Analysis of water of the spring.—**A. N. Labunčov**: Fersmanite, a new mineral from the Khibin tundras. The formula of the mineral is $4RTiO_3 \cdot 2R_2Si(O, F_2)_3 \cdot SiO_2$. Crystals are monoclinous, pseudoquadratic.—**W. A. Lindholm**: Some new molluscs (Pelecypoda and Gastropoda) from the waters of south-eastern Siberia.

Comptes rendus, No. 13.—**P. Lazarev**: A phenomenon of adaptation in peripheral vision. The sensibility of visual centres is an adaptation which changes in accordance with the conditions of life.—**P. Lazarev** and **L. Kuper**: On the action of ions of bromium on the adaptation of the eye in peripheral vision. Sodium bromide depresses the sensibility of the nervous visual centres.—**W. A. Lindholm**: Three interesting water-snails (Gastropoda) from western Turkestan. *Lymnæa* (*Cerasina*) *luteola* Lam. sbsp. *oxiana* O. Boettgar is the only Indian species of the genus in Turkestan. *Physa acuta* Draparnaud is a purely Mediterranean species which has been recently found in Turkestan. *Caspia issykkulensis* Clessin is a *Hydrobia* and closely related to the European *H. ventrosa* Montagu. First snails (Gastropoda) from Lake Kosogol in north-western Mongolia. Descriptions of *Limnæa* (*Radix*) *auricularia*, *L. morpha kosogolensis* nov. and *kobeltocochlea michnoi*, sp. n.—**E. Miram**: Contribution to the knowledge of the genus *Bergiola* Stschelk. (Orthoptera, Tettigonioidea). Redescription of the female of *B. balchaschica* Stschelk. and the description of its hitherto unknown male.—**N. Kusnezov**: Absence from the Crimea of some elements of the Lepidopterous fauna. The autochthonous fauna of the Crimean peninsula appears impoverished as a consequence of (1) the reduction in the area of the peninsula after the sinking of the Pontian continent, which event made Crimea an island; (2) the cooling of its climate during the glaciation; (3) particularly as a result of a reduction in the post-Pliocene immigration from the east because of the isolation. This absence of certain otherwise widely distributed species and the presence of southern species like *Acronycta pontica* Staud., *Triphœna haywardi* Tams, *Eutelia adoratrix* Staud. makes the Crimean fauna approximate to that of the most southern areas of the Mediterranean region, namely, Crete, Cyprus, and north-west Africa.

Comptes rendus, No. 14.—**D. N. Prianishnikov** and **V. N. Ivanova**: The absorption and excretion of ammonia by the roots of plants. Normal plants, with sufficient reserve of carbohydrates absorb ammonia from ammonia nitrate more energetically than they do the nitric acid. When the carbohydrate reserves are exhausted ammonia is excreted by the roots.—**D. N. Prianishnikov** and **S. I. Inozemcev**: A contribution to the physiological characteristics of potassium chloride. Potassium chloride is less acid physiologically than ammonium chloride.—**M. F**

Neuburg: The stratigraphy and age of coal-bearing deposits of the Kuznetzk basin in Siberia. The fossil flora of the basin is more ancient than the Lower Jurassic.—B. Kupletskij: A mineral of the astrophyllite group from the mountain Urma-Varaka in the central area of the Kola Peninsula. The new mineral differs from astrophyllite mainly in the greater content in silica, lesser content in manganese, and a somewhat lesser content in alkalis. In true optical characters it is near lavenit and lamprophyllite.—K. A. Rassadina: A new species of *Umbilicaria* from Siberia, *Umbilicaria pertusa*, sp. n. A species from the shores of Lake Baikal is described.

SYDNEY.

Linnean Society of New South Wales, June 26.—H. G. Raggatt: Calcareous concretions in the Upper Marine Series, Singleton District, N.S.W. Attention is directed to the occurrence of calcareous concretions having an average size of 10 ft. by 8 ft. in plan, by 55 ft. vertically, on a horizon 250 ft. above the Muree beds. They have been noted over an area of 220 square miles. The concretions are considered to have been formed contemporaneously with the enclosing rock in an isolated shallow sea subject to the influx of cold water, the main factor operating to produce continuous deposition being the inverse relation between temperature and the solubility of calcite.—F. W. Edwards: Notes on the Ceroplatinæ, with descriptions of new Australian species. One genus, twelve subgenera of *Platyura*, and one subgenus of *Heteropterna*, and four species are described as new. Keys are given to the subgenera of *Platyura* and of *Ceroplatus*.—Ida A. Brown: A garnet-bearing dyke near Moruya, N.S.W. A record is given of a basaltic dyke outcropping on the coast of New South Wales, ten miles south-east of Moruya, which contains fragments of basic and ultrabasic plutonic rocks, including particularly pleonaste-bearing pyroxenites and large xenocrysts of red garnet, brown hornblende, augite and basic plagioclase, which probably constituted a coarsely crystalline garnet-bearing eucrite. The inclusions are most probably truly xenolithic in origin, and not comagmatic with the basalt; their inclusion in Cainozoic hypabyssal rocks may be due to special tectonic conditions which prevailed over the tablelands and coastal area of eastern Australia during late Tertiary time.

Royal Society of New South Wales, July 3.—I. W. Wark: An extension of the conception of the distribution coefficients. A general thermodynamic treatment of physico-chemical equilibria based upon an extended conception of the distribution process. Initially, relations are demonstrated for the change of the distribution coefficient with temperature and pressure. From these, quantitative expressions are deduced showing how temperature and pressure changes influence different types of equilibria. One and two component systems, with solid, liquid, and gaseous phases are considered, the treatment being identical for physical and chemical processes. A generalised form of the Clapeyron equation is deduced. It is shown in an appendix that the experimental data for the distribution of bromine between air and water confirm some of the deductions.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 5, May 15).—Jenny E. Rosenthal and F. A. Jenkins: Perturbations in band spectra (1). A theoretical examination of certain bands of the CN system.—E. Hill and E. C. Kemble: On the Raman effect in gases. Analysis of experimental results recently obtained for diatomic gases.—A. Sommerfeld: About the production of the continuous X-ray spectrum. Wave-mechanics applied to the continuous spectrum from a thin target.—A. Frumkin and John Warren Williams: The relation between the electric moment and the potential difference at an interface. A discussion of experimental results suggesting that any comparison between these two sets of data can be qualitative only.—Paul S. Epstein and Morris Muskat: On the continuous spectrum of the hydrogen atom. By a new integral representation for the wave function in this special case, expressions suitable for numerical calculations are obtained for the intensities in the continuous spectrum.—F. Rasetti: On a fluorescence spectrum of oxygen. A series of very faint doublets extending from the ultra-violet to the visible and excited by the resonance line λ1849 of mercury which is strongly absorbed in oxygen.—R. J. Lang: On the spectra of Zn II., Cd II., In III., and Sn IV.—Paul Kirkpatrick and Iwao Miyake: Polarisation of the tungsten L radiations. No polarisation of any line was found; one per cent polarisation would have been detected.—John Warren Williams and Alexander Hollaender: A study of the Raman effect in acetone.—M. H. Stone: Linear transformations in Hilbert space: (2) Analytical aspects.—Raymond Pearl, Florence Barclay White and John Rice Miner: Age changes in alcohol tolerance in *Drosophila melanogaster*. For adult flies, the time to reach a definite stage of anæsthesia under a constant dosage of alcohol vapour decreases with age, rapidly at first and then more slowly; the time for complete anæsthesia is generally shorter for females than males. The time-age curve is similar to that of Gompertz for the progress of senescence and also to that for the change with time of surface tension of colloids.—Paul R. Rider: Moments of moments.—Elery R. Becker: Methods of rendering the rumen and reticulum of ruminants free from their normal infusorian fauna. Goats were used. A successful method was to starve the animal for three days, and then give two large doses at 24-hours interval of about 0·4 per cent copper sulphate solution delivered into the rumen by a horse catheter. The animals remain free from infusoria on a diet of alfalfa hay and a grain mixture.—Wilder D. Bancroft and David S. Morton: Monatomic iodine and molecular hydrogen. At temperatures up to 300° C. in the dark, there is very little reaction in glass vessels between iodine and hydrogen; between 300° and 350° there is an enormous increase of reaction velocity. No appreciable photochemical effect was observed. On the other hand, in quartz containers, reaction occurs at ordinary temperatures. Apparently, light in the visible spectrum does not activate hydrogen at the temperatures used, whereas ultra-violet light does. The reaction in the dark at 350° is between thermally produced monatomic hydrogen and molecular (or monatomic) iodine.—Gregory Paul Baxter and Howard Warner Starkweather: The density, compressibility, and atomic weight of argon (2). The argon used in earlier work was found to contain a trace of hydrogen. The new value for the normal density is 1·78394; the limiting density is little affected, so the atomic weight remains 39·944. $(P\,V)_0/(P\,V)_1$ is increased from 1·00090 to 1·00107.—Wilder D. Bancroft and Raymond P. Allen: Photochemical temperature coefficients. The curve of photochemical reaction velocity against temperature seems to consist of three parts, one ascending rapidly at low temperatures, the next being nearly horizontal, and the last ascending rapidly with the approach of thermal instability.—Maynard M. Metcalf: The Opalinidæ and their significance. Suggestions for further study of structure and behaviour; their significance in host-parasite distribution studies.

Official Publications Received.

BRITISH.

Records of the Indian Museum. Vol. 30, Part 3: A Revision of the Indian Ixodidae with Special Reference to the collection in the Indian Museum. By M. Sharif. Pp. 217-344+2 plates. (Calcutta.)

Committee of Civil Research. Locust Sub-Committee: First and Second Interim Reports. (Cmd. 3367.) Pp. 14. (London: H.M. Stationery Office.) 3d. net.

The North of Scotland College of Agriculture. Calendar, Session 1929-1930. Pp. viii+123. (Aberdeen.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 26. Pp. 223. (Wye.) 8s. 6d.; to Residents in Kent and Surrey, 4s. 6d.

County of Northumberland: Education Committee. County Agricultural Experiment Station, Cockle Park: Guide to Experiments for 1929. Report by Prof. Clement Heigham. (Bulletin No. 42.) Pp. 66. (Newcastle-upon-Tyne.)

Bishop's Stortford College. Report of the Proceedings of the Natural History Society, 1928. Pp. 24. (Bishop's Stortford.)

Administration Report of the Travancore Government Museum and Public Gardens for the Year 1103 M.E./1927-28 A.D. Pp. iii+19. (Trivandrum: Government Press.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1928–March 31, 1929. Pp. 8. (Sidmouth.)

Ceylon Journal of Science. Section E: Mathematics, Physics and Meteorology; including Bulletins of the Colombo Observatory. New Series, Vol. 1, Part 3, July 5th. Edited by A. J. Bamford. Pp. 173-240+33 plates. (Colombo: Observatory; London: Dulau and Co., Ltd.) 3 rupees.

Union of South Africa. Department of Mines and Industries: Geological Survey. The Geology of the Postmasburg Manganese Deposits and the Surrounding Country: an Explanation of the Geological Map. By Dr. Louis T. Nel. Pp. 109+12 plates. 10s. 6d. (including Map). The Geology of the Major Portion of East Griqualand: an Explanation of Cape Sheet No. 35 (Matatiele.) By Dr. Alex L. Du Toit. Pp. 36. 5s. (including Map). (Pretoria: Government Printer.)

Proceedings of the Edinburgh Mathematical Society. Edited by Prof. H. W. Turnbull and Dr. W. Saddler. Series 2, Vol. 1, Part 4, July. Pp. 189-257. (London: G. Bell and Sons, Ltd.)

Proceedings of the Cambridge Philosophical Society. Vol. 25, Part 3, July. Pp. 255-367. (Cambridge: At the University Press.) 7s. 6d. net.

Union of South Africa: Department of Agriculture. Science Bulletin No. 69: A Study of some *Alternarias* affecting *Citrus* in South Africa. By E. M. Doidge. Pp. 29. (Pretoria: Government Printer.) 3d.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1928. Pp. 17. (Hong Kong.)

Aeronautical Research Committee. Report for the Year 1928–29. Pp. 63. (London: H.M. Stationery Office.) 2s.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 392, August. Pp. 937-1064+xxxiv. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

FOREIGN.

United States Department of Agriculture. Farmers' Bulletin No. 1586: The Southern Pine Beetle; a Serious Enemy of Pines in the South. By R. A. St. George and J. A. Beal. Pp. ii+18. 5 cents. Farmers' Bulletin No. 1595: The Bollworm or Corn Ear Worm as a Cotton Pest. By F. C. Bishopp. Pp. ii+14. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 7, Part 1, June. Pp. 191+9 plates. (Tokyo.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81. The Orthoptera of Colorado. By Morgan Hebard. Pp. 303-425+plate 11. Notes on the Statoblasts and Polypids of *Pectinatella magnifica*. By Chandler M. Brooks. Pp. 427-441. New Cuban Urocoptidæ, by Carlos de la Torre; The Locomotion of Urocoptidae and Descriptions of New Forms, by Henry A. Pilsbry. Pp. 443-467+plates 12-16. (Philadelphia.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 86: Chippewa Customs. By Frances Densmore. Pp. xii + 204 + 90 plates. (Washington, D.C.): Government Printing Office.) 1.60 dollars.

Smithsonian Miscellaneous Collections. Vol. 81, No. 12: Archeological Investigations in the Taos Valley, New Mexico, during 1920. By J. A. Jeançon. (Publication 3015.) Pp. 29+15 plates. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the United States National Museum. Vol. 75, Art. 5: A Generic Revision of the Fossorial Wasps of the Tribes *Stizini* and *Bembicini*, with Notes and Descriptions of New Species. By Prof. John Bernard Parker. (No. 2776.) Pp. 203+15 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 145: Manual of Second and Third Order Triangulation and Traverse. Pp. v+226+23 plates. (Washington, D.C.: Government Printing Office.) 60 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 2. No. 6, June. Pp. 1001-1211+25 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Mines. Coal in 1927. By F. G. Tryon, O. E. Kiessling and L. Mann. (Mineral Resources of the United States, 1927, Part 2.) Pp. x+327-509. (Washington, D.C.: Government Printing Office.) 30 cents.

Department of the Interior: U.S. Geological Survey. Bulletin No. 794: 'Red Beds' and Associated Formations in New Mexico, with an Outline of the Geology of the State. By N. H. Darton. Pp. xvi+356+62 plates. 1.30 dollars. Bulletin 801: Geology and Water Resources of the Edgeley and La Moure Quadrangles, North Dakota. By Herbert A. Hard. Pp. v+90+5 plates. 50 cents. Bulletin 803: Geography, Geology and Mineral Resources of the Portneuf Quadrangle, Idaho. By George Rogers Mansfield. Pp. vi+110+8 plates. 40 cents. Bulletin 807: Geology of Hyder and Vicinity, South-eastern Alaska, with a Reconnaissance of Chickamin River. By A. F. Buddington. Pp. viii+124+14 plates. 35 cents. (Washington, D.C.: Government Printing Office.)

Field Museum of Natural History. Zoology Leaflet No. 10: The Truth about Snake Stories. By Karl P. Schmidt. Pp. 19. 20 cents. Zoology Leaflet. No. 11: The Frogs and Toads of the Chicago Area. By Karl P. Schmidt. Pp. 15+5 plates. 25 cents. Geology Leaflet No. 10: Famous Diamonds. By Oliver C. Farrington. Pp. 27+5 plates. 25 cents. (Chicago.)

Diary of Societies.

FRIDAY, SEPTEMBER 6.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

CONFERENCES.

SEPTEMBER 8 TO 14.

INTERNATIONAL CONGRESS OF THE WORLD LEAGUE FOR SEXUAL REFORM ON A SCIENTIFIC BASIS (at Wigmore Hall, Wigmore Street).

SEPTEMBER 9 TO 14.

LIBRARY ASSOCIATION (at Brighton).

Lord Balniel: Presidential Address.

Col. J. M. Mitchell: The Small Town in Relation to the County Library System.

A. Esdaile: The Student Reader and his Books.

Discussion on Cataloguing.

L. S. Jast, W. C. B. Sayers, Mrs. A. H. Radice, Miss Belle Rennie, J. W. H. Brown, and F. A. Hughes: Symposium on Children's Reading.

E. Davis and others: Discussion on Books in Elementary Schools.

SEPTEMBER 9 TO 12.

INSTITUTE OF METALS (at Düsseldorf).

Monday, September 9, at 5.—Dr. A. G. C. Gwyer: Aluminium and its Alloys (Autumn Lecture—in German).

Tuesday, September 10, at 9.30 A.M.

Dr. W. Rosenhain: Some Methods of Research in Physical Metallurgy.

G. Masing: Methods of Research in Metallography.

P. Chevenard, A. M. Portevin, and X. F. Waché: A Dilatometric Study of Some Univariant Two-Phase Reactions.

M. Haas and D. Uno: An Improved Differential Dilatometer.

W. H. J. Vernon and L. Whitby: The Open-Air Corrosion and Surface Patina of Copper.

C. O. Bannister: Studies on the Crystallisation of Gold from the Liquid State.

A. G. Lobley: The Creep of 80:20 Nickel-Chromium Alloy at High Temperatures.

Wednesday, September 11, at 9.30 A.M.

W. J. P. Rohn: Reduction of Shrinkage Cavities and Vacuum Melting.

M. Tama: New Methods for Melting Non-Ferrous Metals in the Electric Furnace.

N. F. Budgen: Pinholes in Aluminium Alloy Castings.

O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of Locomotive Firebox Stays and Plates.

A. von Zeerleder and P. Bourgeois: Effect of Temperature Attained in Overhead Electric Transmission Cables.

Dr. J. Newton Friend: The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part II. The Results of Seven Years' Exposure to Air at Birmingham.

C. Blazey: Idiomorphic Crystals of Cuprous Oxide in Copper.

Thursday, September 12, at 8.15 A.M.—Excursion to Krupp Works, Essen.

SEPTEMBER 10 TO 12.

IRON AND STEEL INSTITUTE (at Newcastle-upon-Tyne).

Tuesday, September 10, at 10.15 A.M.

C. S. Gill: Notes on the Damping-Down and Re-Starting of Blast Furnaces.

A. T. Adam: Notes on Wire for Mining Ropes.

A. Hultgren: Crystallisation and Segregation Phenomena in 1 per cent Carbon Steel Ingots of Smaller Sizes.

J. A. Jones: High Elastic Limit Structural Steels.

Wednesday, September 11, at 10 A.M.

J. H. Whiteley: The Coalescence of Pearlite.

H. A. Dickie: The Solubility of Carbide in Ferrite.

T. D. Yensen: Iron-Silicon-Carbon Alloys. Constitutional Diagram and Magnetic Properties.

T. A. Rickard: Iron in Antiquity.

Thursday, September 12, at 10 A.M.

E. G. Herbert: The Hardening of Superhardened Steel by Magnetism. The Lattice Resonance Hypothesis.

E. Diepschlag and F. Wulfestieg: Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to their Temperature and their other Properties.

H. O'Neill: The Hardness of Vacuum-Annealed Crystals of Iron.

J. H. Smith, C. A. Connor, and F. H. Armstrong: The Correlation of Fatigue and Overstress.

SEPTEMBER 16 AND 17.

BIBLIOGRAPHIQUE INTERNATIONALE (at Imperial College of Science).

Monday, September 16.—Council Meetings.

Tuesday, September 17, at 10 A.M.—Prof. A. F. C. Pollard: Presidential Address.

The agenda will include Further Proposals for the Reorganisation of the Institute, Reports of the Commissions on Cataloguing Rules and on Documentary Technique, and a Discussion on the Possible Unification of the Aims and Objects of International Bibliographical Organisations.

NATURE

SATURDAY, SEPTEMBER 14, 1929.

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What is Life?

AT the recent South Africa meeting of the British Association there was a conference on the nature of life, at which distinguished thinkers made interesting contributions, already referred to in our columns. It may be useful to try to gather the various suggestions into a connected whole.

(1) Modern discussions of this perennial question, What is Life? have shown in varying degrees a recognition of the commonplace that an answer lies in a fuller knowledge of living creatures. No amount of verbal dexterity or even profound reflection over the concept of 'life' floating in detachment will get us much 'forrarder' unless we are at the same time deepening our acquaintance with organisms from microbes to men, and trying to see life whole, not as a biochemical witch-pot merely, but as the activity of individualities that develop, grow, and reproduce, that struggle, vary, and evolve. If we are to answer the question, What is Man? or What is Personality? we must deepen our knowledge of men and of personalities, and of Shakespeare and Newton as well as of Bushmen. So to avoid false simplicity in our answer to the question, What is Life? we must seek a comprehensive, all-round, and intimate view of organisms, taking account of intelligent apes as well as of dimly purposive amœbæ, and of psycho-biosis as well as of bio-psychosis. We cannot make sense of any kind of life without recognising the importance of fermentation, but we cannot make sense of the life of higher animals apart from feeling, intelligence, and some sort of purpose; and the continuity of organisms makes it probable that the dim analogues of these psychical qualities are present throughout.

The extreme behaviourists or bio-mechanists, perhaps represented at the conference, to judge from the reports, by Prof. L. T. Hogben, will of course refuse to take account of any process which does not admit of physico-chemical analysis and description—a position that does not work out well in our daily life and conversation, where we have to allow at every turn for intelligent or even rational purpose—but even these extremists will agree that an understanding of life is most likely to follow a widening of our study of actual organisms.

(2) No one has as yet succeeded in re-describing in terms of anything else a fair and intact sample of that distinctive kind of activity that we call life; and it is *possible* that the nature of life lies outside the realm of the knowable, as the non-committal Prof. Barger suggested at the conference. Such

being our ignorance, we advance to a second proposition, that it is always useful to return to the bedrock of facts and seek to envisage *living*, if we cannot understand *life*. Living always means that living creatures act on their surroundings and are acted on by them. Taking the first letters of the three biological co-ordinates—organism, function, and environment—Prof. Patrick Geddes suggests as a descriptive definition of living—$O \rightarrow f \rightarrow e : E \rightarrow f \rightarrow o$. In condensed form, living is an ever-changing ratio between *Ofe* and *Efo*, or *Ofe*/*Efo*, the numerator aspect being prominent at one time, the denominator aspect at another. This is obviously no definition of 'life', since the words organism and function imply the whole mystery; yet it is a very useful positivistic conception; and it may save us from the fallacy of trying to define organism apart from environment. Whatever be the true inwardness of life, the facts that we study are $O \rightarrow f \rightarrow e : E \rightarrow f \rightarrow o$.

(3) It is always useful to get below superficial differences to fundamental resemblances. Thus it was a notable step when Huxley united birds and reptiles as Sauropsida, and a still greater when Claude Bernard justified Linné's term Organisata, by showing in detail the phenomena common to the life of plants and animals. On the other hand, there is danger in satisfying our desire for unity, or for continuity, by sticking the same label on things or processes which remain very different. Thus the word 'evolution' is used as a label for a variety of genetic processes which have not very much in common save that they are modes of becoming.

There is a tendency to do the same with the word 'life' or 'organism'. It is generally admitted that Herbert Spencer did more harm than good with his term 'social organism', and Whitehead has deliberately made the same mistake in the opposite direction, in his disclosure of the organism-like character of the atom. So our third proposition is that, when all is said, the orders of fact indicated for short by the terms 'matter', 'life', and 'mind' remain very different from one another. Perhaps it would be clearer to say that 'cosmosphere', 'biosphere', and 'sociosphere' are three different worlds, one within the other, each with its own concepts, categories, or descriptive formulæ. No one stands for continuity more firmly than General Smuts, yet he insists that 'matter', 'life', and 'mind' are disparate orders of fact. This does not mean that they are separated by hard and fast boundaries, for organisms are whirlpools of matter and energy, and the members of a human society are rational mammals, and mind is clearly emergent in many an animal. Yet if anything is gained something is lost by speaking of the life of crystals or the organism of the atom, or the fellowship of molecules, or the society of cells in the body. Organism, for example, is a clear-cut well-established term, and it should be kept for genuine organisms, not blunted by application to atoms on one hand or human societies on the other.

Thus our third proposition is that the domain of things, the realm of organisms, and the kingdom of man (where mind plays a dominant part) are three distinct orders of fact, each with its characteristics—distinct though they overflow and interpenetrate, distinct though their continuity is becoming increasingly clear.

(4) It is time to put an end to the pitting of mechanistic and vitalistic descriptions against one another, as if one must choose between them. Every reasonable vitalist, whatever school he represents, wishes good speed to chemico-physical analysis and description; his protest is that the sea of reality contains fishes which escape the chemico-physical nets. There is no chemical test for feeling; there is no balance that will weigh a purpose. Yet the vitalist believes in the reality of feeling and purpose; and is rather amazed that anyone can disagree with him. Every vitalist wishes to see bio-chemical and bio-physical analysis pushed as far as they will go, but care must be taken not to pretend that the bio-chemical and bio-physical concepts suffice for the description of the whole of life or living. It is also a little naïve to suppose that atoms and radiations and the like form a sort of bedrock of reality, the fact being that they are only certain aspects of reality which become clear when certain methods are used in certain fields.

Similarly, in the opposite direction, there are legitimate transcendentalisms, as when we refuse to leave out feeling or the like in our account of animals; or when we consider the possibility that something analogous to the mental aspect of an intelligent animal may be at work in the implicit organism which we call the developing ovum. Smuts suggests that mechanism and vitalism should both be discarded as mischievous survivals, but that is impossible. They represent two legitimate ways of looking at living creatures. It is true, however, that they require to be replaced by neo-mechanism and neo-vitalism, for the mechanistic formulations of to-day are not those of fifty years ago, and vitalism has also been changed by a deepening knowledge of the non-living and of the unconscious. Our fourth proposition is that

mechanistic and vitalistic descriptions are not only legitimate, but even necessary.

(5) The extreme mechanistic position is not that there is a chemistry and a physics of the living organism, for that is admitted by all; it is that the concepts of chemistry and physics suffice to cover the whole field of life. When Dr. J. S. Haldane punctures a mechanical description of the work of the kidneys or the lungs; or when Smuts points out that many of the reactions of organisms differ from those of non-living systems in being the unified responses of co-ordinated wholes of a higher order than, say, atoms or chemical compounds; or when Driesch shows how mechanistic formulæ fail to grip the facts of development, and so on, the mechanists point to what the future has in store in the way of complete mechanistic description. This is unanswerable, though it may seem optimistic. It remains, however, for the vitalist to point out that in the higher reaches of life the mental aspect is undeniable, and that mentality cannot be juggled out of mechanism. Moreover, to put a long argument briefly, a machine cannot have a theory that it is a machine. Our fifth proposition is that mechanistic methods are indispensable and invaluable, but have their dangers just like facile vitalistic ones, and do not lead to adequate descriptions of living.

(6) At the opposite pole is positive vitalism, ably represented at the conference by Prof. Wildon Carr, who maintained that mechanism is not to be supplemented, but is to be rejected as a wrong way of approaching the problem. He stood for the postulate of an 'entelechy', a positive principle in virtue of which an organism is an individual whole and acts as such. The essence of life is individual and purposive activity, and this is original and of the essence of reality. What we know of matter does not help us to understand life and mind.

A radical objection to this view is the apparent continuity of evolution. For it looks as if living organisms had emerged (at present one of the 'blessed' words) from non-living materials; it looks as if undeniable 'minds' or mental aspects had arisen as new syntheses in animals the ancestors of which were not more than latently mental, just as the clever child arises in individual development from an egg-cell, the 'mind' of which is far to seek. But Wildon Carr rejects the precedence of matter to life, and of life to mind.

In an interesting way Wildon Carr turns the tables on General Smuts by declaring that he is an entelechist without knowing it. According to Smuts, evolution has been a progressive emergence of higher and higher 'wholes', such as the atom, the cell, the vegetative organism, the animal with an embodied mind, and the human personality. A new 'whole' is a fresh synthesis the intrinsic nature of which admits of new agency, creativeness, and freedom. The progressive emergence of 'wholes' in Nature allows of the expression of fresh aspects of reality; and if it be asked why there should be this tendency to whole-making, Smuts replies, we think, that such is the nature of things. Within the scientific universe of discourse Smuts refuses to invoke any *deus ex machina*. Yet when he defines holism as "the ultimate synthetic, ordering, organising, regulative activity in the universe which accounts for all the structural groupings and syntheses in it, from the atom and the physico-chemical structures, through the cell and organisms, through mind in animals, to Personality in man", we are afraid that he lays himself open to Wildon Carr's charge of "using a wrong word 'holism' when the right word 'entelechy' was staring him in the face". Yet of the two formulators, we think that Smuts keeps nearer than Wildon Carr to the facts of the case; for holism emphasises continuity and evolution.

(7) Finally, it seems to us that the most tenable position is what may be called 'methodological vitalism'. Mechanistic descriptions are indispensable, and we owe to the mechanists in particular a deeper understanding of the environmental factor in living ($E \rightarrow f \rightarrow o$). But at its best, at present, mechanistic formulation is far from giving us an adequate account of the life of organisms. Vitalistic descriptions are also indispensable, for whether the organism has an entelechy at heart, or whether it is one of a long series of 'syntheses', or 'integrates', or 'wholes', its life cannot be adequately described in terms of mechanism. The vitalists have done good service in emphasising the organismal factor in living ($O \rightarrow f \rightarrow e$), and also, of course, the functioning factor, for life is *par excellence* activity, as Wildon Carr so well insists. But the scientific inquirer is not fond of 'principles' or 'entelechies', and he dreads 'vital forces' in disguise; so what can he do but maintain not a positive but a methodological vitalism? That is to say: as things are at present, the mechanistic formulation of organisms and their functionings in their environments does not answer the distinctively biological questions. Biology has concepts of its own at present irreducible to chemistry and physics: the living creature is a historic being enregistering its experience; it is a purposive individuality that gets things done; it grows, multiplies, develops, struggles, varies, and evolves; it often has a mind of its own.

Pavlov's Collected Addresses.

Lectures on Conditioned Reflexes: Twenty-five Years of Objective Study of the Higher Nervous Activity (Behaviour) of Animals. By Dr. Ivan Petrovitch Pavlov. Translated from the Russian by Dr. W. Horsley Gantt, with the collaboration of Prof. G. Volborth. Pp. 414 + 4 plates. (London: Martin Lawrence, Ltd., n.d.). 18*s*. net.

BEFORE 1927 there was no systematic account in the English language of the extensive investigations into cerebral function by Prof. Pavlov and his school, commenced in St. Petersburg a quarter of a century earlier. In that year, however, the Oxford Press, aided by the Royal Society, published the translation by Dr. Anrep of a course of lectures which had been delivered by Pavlov in 1924, and so gave to readers of English the first complete conspectus of those researches of which they had so long been deprived.

Dr. Gantt now adds to the resources of the literature by translating what are, in fact, Pavlov's "Collected Addresses"—collected over a period of twenty-five years. It is indeed unfortunate that Dr. Gantt has not used the term for the title of this volume and so eliminated any risk of its confusion with the synoptic lectures of 1924. A personal sketch of Pavlov forms an appropriate preface to a book with the autobiographical character which is inseparable from a set of forty-one lectures delivered at intervals during a long life of research, and Dr. Gantt has produced a vigorous account of the master himself, his outlook and his methods. In the substance of the lectures one finds much overlap and repetition, which are inevitable when the evolution of a research is described before different audiences at short intervals of time. But these re-statements sharpen the focus of the problem and present to the reader the living difficulties of the research.

The word 'reflex' has been given by Pavlov a much wider connotation than has ever been demanded of it by workers on the spinal cord and lower cerebral centres. The simpler reflexes are inborn and have an inevitable fatality of action. On the other hand, the conditioned 'reflexes'—conditional would have been a happier epithet, but it died unborn—are acquired during life by the training method, as Kalischer calls it. Pavlov prefers to define the conditioned reflex as "an act of synthesis by the [cerebral] hemispheres of the animal". The reflex is only a temporary affair, not lasting many weeks or months beyond the cessation of the events producing it.

From the beginning of the research, the Russian school has viewed the phenomenon from a sternly objective approach, even if in the early days that led to the extremity of imposing a fine in the laboratory "for the use of such psychological expressions as the dog guessed, wanted, wished, etc.". By training, a dog's mouth can be made to water before a meal (unconditioned stimulus) by some preceding visual, auditory, or cutaneous stimulus (conditioned stimulus). This is evidence of the employment of a certain nervous path possessing centripetal, central, and centrifugal elements, in fact the "reflex arc of the physiologist". On this objective basis the work of the Russian school has been pursued. Within the cerebral hemispheres lie the central elements of the reaction, here given unsubjective treatment for the first time so baldly as though to blast for ever speculation on their nature. Of the centripetal element, there is much of interest to physiologists concerning receptor organs and receptive apparatus ('analyser'). That the dog can distinguish as an excitatory stimulus (announcing-food) a tone of 1000 vibrations a second from one of 1012 as an inhibitory stimulus (announcing-no-food) is indeed remarkable. This feature, as well as the lack of colour discrimination and many other *notabilia*, is already familiar to readers of the treatise of 1927.

The heart of the problem which the Russian physiologists have set themselves is the nature of the central elements of the conditioned 'reflex'. One of the simplest examples of differentiation in the central nerve-mass is that between 100 and 96 metronome beats a minute. Nociceptive skin stimuli too can be brought, by inhibition of the 'defence-reflex', to have a benign implication and be used as conditioned stimuli for pre-prandial salivation. The complex events of spread of 'irradiation' of excitation and of inhibition through the central nerve-mass are shown to have well-defined temporal and spatial relations, which closely resemble the processes occurring in lower nerve centres on a humbler scale. The phenomenon of sleep as an irradiation of internal inhibition comes often within the purview of this study. The abnormal reactions of hysteria (strengthening of inhibition) and of neurasthenia (weakening of inhibition) are touched on.

Nevertheless, there are deep waters which objectivism plumbs uncertainly for the present. To say that a dog exhibits the 'guarding-reflex' when it is hostile to strangers in its familiar experimental room seems to be nothing more than the alteration of a label from 'instinct' to 'reflex'. But the

change in title may be justified if it heartens the strict objectivist to further research. When a dog shows resentment to being held in harness for experiment, it is said to show the ' reflex of freedom '. We are told, naïvely enough, " perhaps a sensitive dog ". Especially in the later lectures there recurs the word ' temperament '—an uncontrollable but not entirely unstable factor dominating the whole field of research into acquired reflexes, intensifying the difficulties and demanding from the workers a fund of patience. To many critics this dominance of ' temperament ' may appear to beg the whole question of the study being objective. At least, it presents problems for solution.

Dr. Gantt's translation deserves welcome, if only for the single reason that it enables us to follow chronologically the development of a subject which has been pursued by the Russian school with a virile endeavour worthy of the greatest traditions. Pavlov calls endeavour a ' reflex of purpose ', pointing, be it said, to the Anglo-Saxon for its highest personification. However this quality may be named, it is surely that which lifts animals out of the category of mere flotsam, bewafted on an ocean of fatalism, and is none other than conation. In describing this ' reflex of purpose ', Pavlov asks the question, " What is the chief condition for attaining a goal ? " and supplies an Anglo-Saxon answer, "The existence of obstacles". Such, then, is the ' reflex ' which has led him and his pupils to great achievements in physiology. E. G. T. L.

The Metallurgy of Iron and Steel.

(1) *Blast Furnace Practice.* By Fred Clements. Vol. 1 : *General Principles ; Source, Preparation and Handling of Raw Materials.* Pp. 538. (London : Ernest Benn, Ltd., 1929.) 63*s*. net.

(2) *Practical Steelmaking.* By Walter Lister. Pp. xii + 413 + 44 plates. (London : Chapman and Hall, Ltd., 1929.) 25*s*. net.

(3) *Photomicrographs of Iron and Steel.* By Everett L. Reed. Pp. xx + 253. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1929.) 20*s*. net.

METALLURGY is a science as well as an art, and its processes are of great interest to the physical chemist as well as to the technical man. As the need for more efficient production is more strongly felt, empirical and long-established methods of manufacture receive scientific study, and great improvements are made possible by the application of knowledge obtained in the laboratory, often without thought of any immediate use. A consequence of this is that there is an increasing demand for trained men in the industry, and the standard of knowledge of pure chemistry and physics which is required of them is much higher than it was even ten years ago. Hence the need for trustworthy books dealing with the several branches of the subject, suitable for readers who look for something more than the mere catalogue of processes and plant which has composed so many of the larger text-books of metallurgy in the past. The standard is being raised, and we expect of an author that he shall show an acquaintance with the scientific foundations of manufacturing processes as well as with the details of their operation. It is gratifying to find that many such works are now available, and the serious metallurgical student is being helped by having authoritative information put before him in a readable form.

(1) The blast furnace is one of the most interesting of all large-scale appliances used in industry. To a chemist approaching the metallurgy of steel for the first time it may seem strange that the production of crude pig-iron from the ore, followed by an elaborate process of refining, should have superseded so entirely the ancient direct process of making soft iron or steel from the ore in one operation, and that the efforts of so many modern inventors to return to the old method and to eliminate the blast furnace should have been so completely without result. Actually, the modern blast furnace, crude as it may appear, is an extraordinarily efficient appliance, when account is taken of all its by-products. It has evolved by gradual steps from the ancient furnace reducing a few pounds of ore at a time to the immense American furnaces with a production of as much as 1000 tons in twenty-four hours, whilst the combustible gases issuing from its throat, and formerly allowed to burn wastefully in the air, now supply the whole of the power needed by large plants.

Mr. Clements has already rendered great services to the metallurgical world by his compilations of facts concerning British blast furnace, Siemens furnace, and gas producer practice, contributed in the form of papers to the Iron and Steel Institute, and summed up in large folding tables which are to be found in use in many laboratories and works. He has now undertaken the task of writing a comprehensive text-book of blast furnace practice, for which there is a real need. The single volume originally projected has grown into three, the first of which is now before us. He has done his work well and conscientiously, and has been well supported by the publishers, so that the volume is

excellently printed and illustrated, the only objection which some readers (but not the reviewer) may raise being the unusual width of the page, making a long unbroken line. After certain general chapters the work treats of the sources and mining of iron ores, the supply of fluxes, the production of coke, the use of the hot blast, and the methods of handling raw materials. The actual construction of furnaces and of stoves is to follow.

Although information has also been collected from American and Continental sources, the book deals chiefly with English and Welsh practice, the interesting Scottish furnaces, working with splint coal, being omitted. The tables, however, contain full particulars of dimensions, charges, temperatures, output, and many other details of typical furnaces selected from many parts of the world, and this feature will be found invaluable. German practice receives fuller attention in the chapter on coke ovens. Methods of mining are treated of more fully than might have been expected in a work concerned with the blast furnace, and this section is of great interest, as is that which describes the methods of handling raw materials, a matter of great importance where the quantities are so enormous. The subject is discussed in a most readable manner, and Mr. Clements's book will become the standard treatise on the subject.

The weakest portion is that which deals with the metallography of cast iron and with the chemical reactions in the furnace. Although very full, and containing much that is of great interest, these chapters cannot be taken as representing the latest knowledge on what is admittedly a difficult subject. The great difficulty of obtaining equilibrium in laboratory experiments on the reactions between solids and gases has led to the publication of much inaccurate work, and the task of the scientific critic is a hard one. The reader who is interested in the physical chemistry of iron smelting will do well, therefore, to consult recent literature for the more accurate equations and equilibrium diagrams which have superseded many of those contained in these chapters. This, however, lessens in only a small degree the usefulness of a valuable book.

(2) Mr. Lister's volume is the most satisfactory book on practical steelmaking that we have yet seen. The author, a steel works manager, has a vigorous style, and has written an admirable account of the more important processes, in which he has no hesitation in expressing his own views, based as they are on an extensive experience. He is concerned only with the production of the ingot, the section on ingot structure and defects being short and rather perfunctory. For information on this subject one must look elsewhere, but the actual melting operations are treated with fullness and accuracy, whilst the important matters of furnace maintenance and repair are discussed with the knowledge which comes from familiarity. Furnaces are described with the aid of clear diagrams and photographs only so far as is necessary for an understanding of their working, and we are spared the masses of details from furnace builders' catalogues which occupy so large a space in many textbooks.

Modern British practice is mainly dealt with, so that the Bessemer process is disposed of in two short chapters, and it is evident that the author looks on the acid Siemens process as the best for the making of good steel, although his account of the basic progress is full and fair. Probably metallurgists accustomed to the making of steel of the highest quality would speak more approvingly of the electric furnace than he does, but his warning that it is quite possible to make very bad steel in an electric furnace is one that should be taken to heart by less experienced melters. Much harm has been done to the use of the electric furnace by the impression, at one time too common, that any inferior material, once put into an arc furnace, could be made into steel of high quality. Crucible and high-frequency melting are not mentioned, and it is evident that the author has been chiefly concerned with the larger processes, the account of alloy steels being the least thorough portion of the book, only a few being included. Printing and illustrations are excellent.

(3) The idea of producing an album of standard metallurgical photomicrographs has appealed to many, and several such have been published. Whilst the student may no doubt derive useful information from the study of a series of typical structures, provided that the quality of the photographs is satisfactory, the extent of such benefit may easily be overrated. In regard to alloy steels, in particular, the structures vary in such a fashion that no amount of external help of this kind can replace a first-hand practical acquaintance with their changes under different conditions, whilst even for the simpler steels the range of variation is very wide. A reference album must therefore be suggestive rather than authoritative.

Bearing these limitations in mind, Mr. Reed has produced an excellent collection of photographs. With few exceptions, grey cast irons being the most conspicuous, the structures are clearly reproduced and sufficient data are given to allow of a check by

repeating the experiment for one's self. The half-tone blocks are not comparable in beauty with the collotype plates of the admirable German album, nor do they cover so wide a field, but they include most of the types which will be met with by the young metallographer in practice. The book has been made unnecessarily large and heavy by the excessive number of half-titles and blank pages, combined with the use of a heavy glazed paper. It will no doubt be found most useful by American students, for whom it was written. The high standard of photography of metal specimens reached by some metallographers on the other side of the Atlantic is admired by all, and Prof. Sauveur, who contributes a preface to the present work, has done much to bring about that excellent result. C. H. D.

Studies of Fungi.

(1) *The Gasteromycetes of the Eastern United States and Canada.* By Prof. W. C. Coker and Prof. J. N. Couch. Pp. ix + 201 + 123 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1928.) 55*s.* net.

(2) *Comparative Morphology of Fungi.* By Prof. E. A. Gäumann. Translated and revised by Prof. C. W. Dodge. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiv + 701. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 37*s.* 6*d.* net.

(3) *Kryptogamenflora für Anfänger: eine Einführung in das Studium der blütenlosen Gewächse für Studierende und Liebhaber.* Begründet von Prof. Dr. Gustav Lindau. Fortgesetzt von Prof. Dr. R. Pilger. Band 1: *Die höheren Pilze. Basidiomycetes, mit Ausschluss der Brand- und Rostpilze.* Von Prof. Dr. Gustav Lindau. Dritte Auflage völlig neu bearbeitet von Prof. Dr. Eberhard Ulbrich. Pp. xii + 497 + 14 Tafeln. (Berlin: Julius Springer, 1928.) 29·50 gold marks.

(4) *Fungi: an Introduction to Mycology.* By J. Ramsbottom. (Benn's Sixpenny Library, No. 68.) Pp. 80. (London: Ernest Benn, Ltd., 1929.) 6*d.*

IT is no secret that in large groups of fungi systematics have been in a bad way. Different authors have used different specific and even generic names for the same thing, and, on the other hand, the same specific name has often been used in different localities for different organisms. It is becoming a commonplace, at least in certain groups, that one of the first necessities for correctly interpreting the author's use of a name is the examination of material which at some time has been authenticated by that author. Many observations on fungi are, from their nature, critical, so that an account, or description, or figure of a fungus by any given author really represents a statement of his opinion about it. If the views of several writers become compiled into one account, this account does not necessarily represent the views of any first-hand observer. The advance of mycology is therefore dependent on the accumulation of authenticated material and of the authentic opinions of first-hand observers. Some such view must be in the mind of any reader of the books now under review.

(1) In the first book on our list, the authors have produced what has every appearance of being a first-class handbook of the East American Gasteromycetes. They have taken full opportunity of qualifying themselves for the work; they have examined numerous specimens, are well abreast of the world literature, and one of them has visited the classical European herbaria. Of late years, photography has been developed to supplement descriptions, but scarcely before on this munificent scale except, perhaps, in some books on the Agarics. More than a hundred plates are devoted to photographs of specimens and a further twenty to careful drawings of spores and other microscopical detail. There are artificial keys to the families, genera, and species. Each species is fully described in English from specimens when these were available. When reliance is placed on the descriptions of other writers their names are given. Under each species all approved published illustrations are cited, together with the available collections from eastern America, but not, unfortunately, the bibliographic origin of the species. The geographical area covered is from the east coast to the Mississippi, but the writers have not allowed themselves to be unduly cramped by this limitation.

Altogether one feels that this is the real thing, a full illustrated account of the genera and species of a group small enough to be known personally to the authors. Whatever questions may later emerge as to the range of variation of any given species, no difficulty should be experienced in establishing the forms on which the present authors rely for maintaining the species which they have recognised.

(2) Gäumann's great work has now been translated into English. The German original has

previously been reviewed in NATURE (vol. 117, p. 820), and its general theme explained. The relationships of the fungi are considered and great stress is laid on the bearing of cytological work on affinity. The English translation renders this account very much more available to the student, and it may fairly be said that the book is indispensable. The translator has aimed at presenting Gäumann's views rather than giving a literal translation, and has not hesitated to introduce modifications suggested by two years' additional research. Out of the hundred and twenty odd orders and families recognised, alterations, sometimes extensive, have been made in the treatment of about one-tenth, a sufficient indication of the rate of progress during this brief period.

While admiring the performance, one is apt in some sections to have a sense of insecurity, to feel that there is a veil between the reader and authentic opinion. The copious bibliography is intended to bridge this gap, and, in fact, is often sufficient. Take the statement, "*Ceratostomella fimbriata*, the cause of black rot of the sweet potato, has an imperfect stage formerly known as *Sphæronema fimbriatum*" (p. 262). A reference to the literature cited shows that there has been a misconception. Again, the legend to text figure 145 reads: "*Pleospora herbarum* 1. Section through immature perithecium. . . . After Arnaud 1918." Reference to Arnaud's paper shows that his figure is entitled "*Pleospora* sp. (Type *Pl. herbarum*)", and that it has been 'improved' in redrawing. On the literature cited, Fig. 145 does not represent an authentic opinion of the structure of *Pl. herbarum*. At other times the descriptions of the figures do not truly convey the views expressed in the text. The legend to Fig. 179 reads "*Sphærulina intermixta*. Its growth forms known as *Dematium pullulans*. . . . After Brefeld." On the next page we read, "This type of germination has not been reported elsewhere, and probably was based on impure cultures". A more serious conflict of figure and authentic opinion (avoided in the original German) occurs on p. 325 with *Sclerotinia sclerotiorum* and *Botrytis cinerea*.

In so vast an effort such slips are inevitable and do not greatly impair the value of the work. No author has, for many a year, covered this whole field, and it is perhaps doubtful if a single author will feel justified in again attempting it.

(3) The last two books are on a different plane. The first volume of the third edition of the "Kryptogamenflora für Anfänger" has been much enlarged—to twice the size of the corresponding volume of the second edition. It covers all th genera of the Basidiomycetes, excluding the rust and smuts. A general part introduces the reade to the subject—collection, examination, preserva tion, and classification of fungi—and then he is le straight into the attempt at naming them with th help of keys, short descriptions, and a number c line drawings.

(4) The British contribution to our knowledge c fungi is represented in Mr. Ramsbottom's littl book, in which he neatly skims the cream of curren biological work on the group. Fungi are no animals or truly plants, but they lay toll alike o the living and the dead of both; they have a *flai* for intimate association with the dominants i many a natural habitat—forest, heath, rock, ice and desert, and it is now held that they form a integral part of the 'essential guts' of severa genera of insects. Their bizarre habit of digestin their food before they eat it provides the starting point of several thriving industries, and a fungu has before now affected the course of politica history. The judicious examples chosen shoul lure the public into an interest in these fascinatin organisms, and will, at the least, introduce them t strange realms of knowledge.

Enzyme Research.

Die Methodik der Fermente. Herausgegeben vo Carl Oppenheimer und Ludwig Pincussen. Lie ferung 4. Pp. 7 + 945-1264. 28 gold marks Lieferung 5. Pp. xxx + 1265-1578. 28 gol marks. (Leipzig: Georg Thieme, 1928 and 1929.

THIS treatise, forming Vol. 3 of Prof. Oppen heimer's "Die Fermente und ihre Wir kungen", of which it forms the complement, wa reviewed in our columns when the first 944 page of the text had been published (see NATURE Nov. 3, 1928, p. 676). We are now in a position t deal with the entire work.

The work is divided into three main section which are subdivided into sub-sections an chapters, the text being written by leading authori ties drawn from all parts of the world. Essentiall it is a practical treatise, dealing with method rather than with theories, but here and there it ha been found necessary to introduce theoretical con siderations by way of making the text clea There are 461 illustrations of the most recent form of apparatus, including diagrams and curves. Th value of the book is considerably enhanced by thes With few exceptions the methods of isolating, pur fying, and estimating the power of enzymes a

based on work of comparatively recent date, yet so great has been the activity in this field of research during the past twenty or thirty years that it is well-nigh impossible for any individual to piece together the voluminous fragments of the literature without the aid of such a treatise as the one before us. Hence the *raison d'être* of the work.

The authors have been exceedingly happy in their choice of contributors, and since a commentary on each individual chapter is out of the question on account of their large number, the selection of a few of the chapters must suffice for this purpose.

To Prof. P. A. Levene has been entrusted the preparation of the chapters on the nucleoproteins and their derivatives, and the phosphatides, whilst Prof. Neuberg and Miss M. Kobel deal with the sugar phosphates and with phytin. The significance of the hexose phosphates, discovered independently by Harden and by Iwanoff in 1906, in alcoholic fermentation is well known, and the recent work of Robison goes to show that they are concerned in ossification, whilst that of Embden shows that they play a rôle in the contractile and recovery processes of the muscles. They also appear to take part in the formation of polysaccharides.

The matter concerning the proteases covers 155 pages of the text. Dr. W. Grassmann deals with the detection, isolation, and estimation of those of vegetable origin, and Dr. E. Waldschmidt-Leitz with those of animal origin. Dr. H. Kleinmann describes nephelometric methods for investigating trypsin, and Prof. Pincussen deals with the Abderhalden reaction.

The sub-section on demolases covers no less than 313 pages of text. What may be regarded as a general chapter is written by Dr. F. G. Fischer. It is concerned with oxidations with molecular oxygen, oxido-reduction reactions, peroxidase reactions, and catalysis of hydrogen peroxide. Prof. Thunberg has written the chapter on acceptor methods, dehydrases of the carboxylic acids, and on oxido-reduction reactions. All the latest methods are here clearly described. The chapter on the sulphur system is from the pen of Sir F. Gowland Hopkins, who gives a complete and succinct account of our knowledge of glutathione, its preparation, functions, and reactions. Resting bacteria are dealt with by Dr. J. H. Quastel. Prof. Neuberg with his colleagues contributes chapters on alcoholic and lactic fermentation, lactacidogen, phytochemical reduction, carboxylase carboligase, and alcohol dehydrase. The chapters on yeast zymase and on the co-enzyme of yeast are written by Prof. A. Harden. Aldehydrase and oxygenase are dealt with by Prof. A. Bach. Prof. E. Newton Harvey contributes a chapter on luciferase, a substance having many of the characteristic properties of an enzyme which plays a rôle in plants and animals by the production of light.

The methods described under the heading of capillary analysis by Prof. J. Grüss are of quite a novel character. He gives directions for the detection of enzymes in tissues by micro-chemical and macro-chemical methods.

A subject matter index is appended.

We believe that sufficient comment has now been made on the book to warrant us in recommending it strongly, with the previous two volumes, to those engaged in the study of enzymes. Without doubt it and its companion volumes constitute the most complete and up-to-date treatise on the subject.

ARTHUR R. LING.

Our Bookshelf.

(1) *Romance of the Moon.* By Mary Proctor. Pp. xii + 262 + 7 plates. (New York and London: Harper and Bros., 1928.) 7*s.* 6*d.* net.

(2) *The Story of the Moon: a Description of the Scenery of the Lunar World as it would appear to a Visitor spending a Month on the Moon.* By Garrett P. Serviss. Pp. xii + 248 + 28 plates. (New York and London: D. Appleton and Co., 1928.) 10*s.* 6*d.* net.

THESE two popular books on the moon are in many ways complementary. There is very little overlapping of subject matter, and both may be read with advantage by those whose interest in our satellite has been aroused.

(1) Miss Proctor's book deals with a wide range of subjects connected with the moon in a pleasantly discursive manner which makes easy reading. An introductory chapter on "The Magic Spell of Moonlight" is followed by explanations of the moon's motions, phases, eclipses, the tides, and kindred phenomena, farced with literary allusions or quotations bearing on the subject. The quotations are so numerous and lengthy throughout the book as to give it in places the appearance of merely a well-arranged anthology.

The principal physical features of the moon are briefly described, illustrated by photographs taken with the 100-inch Mount Wilson telescope, and various theories as to their origin explained. The second half of the book is devoted mainly to popular superstitions, folk-lore, and weather prophecies connected with the moon. This section includes an interesting chapter on facts and fallacies involved in various suggested methods of travelling to the moon, with Prof. Goddard's rocket used as a text.

(2) Mr. Serviss is concerned mainly with descriptive selenography. He leads beginners by pleasant stages to an acquaintance with the chief features of lunar topography and an understanding of their

nature, by discussing a series of 21 photographs taken at the Lick Observatory. These represent the moon in successive stages throughout a lunation, the principal objects being pointed out and discussed as they become illuminated by the sun. A few special districts, such as Theophilus, Tycho, and Mare Serenitatis, are described more in detail by the aid of photographs on a larger scale. There is a brief introductory chapter which, with occasional later interpolations, explains the moon's motions, size, phases, and similar matters.

The book is written in the form of conversations between the author and a conveniently inquisitive friend who study the photographs together. This style, though possibly unpleasant to some, is not unduly obtrusive, and has the advantage of sustaining interest in the subject in an easy and natural manner.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 13, 1928. Pp. 760. (London: Society of Chemical Industry, 1929.) n.p.

THE thirteenth issue of this important annual review of applied chemistry is no less welcome than its predecessors; it conforms to the high standard which one is accustomed to expect as regards both quality of material and extent of the ground surveyed. The present volume, like that for 1926, contains a chapter dealing with explosives (J. Weir), the survey in this case covering the two-year period. The sections concerned with general matters, plant, and machinery (A. J. V. Underwood); mineral oils (A. E. Dunstan); colouring matters and dyes (C. Hollins); soils and fertilisers (E. M. Crowther); sugars, starches, and gums (L. Eynon and J. H. Lane); the fermentation industries (H. Lloyd Hind and F. E. Day); and foods (F. S. Aumonier and J. King) have again been entrusted to those who contributed similar chapters last year, whilst the other reports are: fuel (H. J. Hodsman); gas, carbonisation, tar and tar products (H. Hollings); fibres, textiles, cellulose, and paper (J. C. Withers); bleaching, dyeing, printing, and finishing (L. G. Lawrie); acids, alkalis, salts, etc. (C. J. P. Bateson, H. M. Broadhurst, A. Lamble, and A. Williams); glass (H. W. Howes); refractories, ceramics, and cements (W. J. Rees); iron and steel (W. H. Hatfield); non-ferrous metals (A. R. Powell); electrochemical and electrometallurgical industries (H. T. S. Britton); oils, fats, and waxes (T. P. Hilditch); paints, pigments, varnishes, and resins (C. A. Klein, T. H. Barry, R. P. L. Britton, R. G. Daniels, and W. E. Wornum); india-rubber (D. F. Twiss); leather and glue (F. C. Thompson); sanitation and water purification (J. Haworth); fine chemicals, medicinal substances, and essential oils (W. H. Linnell); and photographic materials and processes (E. P. Wightman).

Although it is scarcely probable that there are many chemists who are unaware of the existence of this annual volume, it is perhaps worth mentioning that the reports, whilst detailed and abundantly provided with references, do not pretend to exhaustiveness, but rather aim at providing a readily assimilable summary of the main directions of advance. Hence their perusal forms a most valuable prelude to the study of the abstract literature in the examination of chemical problems.

A. A. E.

Volumetric Analysis. By Prof. Dr. I. M. Kolthoff, with the collaboration of Dr. H. Menzel. An authorised translation based upon the German edition by Prof. N. Howell Furman. Vol. 1: *The Theoretical Principles of Volumetric Analysis.* Pp. xvii + 289. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 15*s.* net.

THE volume under notice is perhaps the first successful attempt to gather together the underlying principles of volumetric practice. The author has utilised such parts of his previous publications on potentiometric methods and indicators as have a bearing on volumetric analysis. It may be stated at once that this theoretical introduction should prove invaluable to practising chemists and to students generally, for it gives precise information on titration and neutralisation curves, oxidation-reduction indicators, complex ion titrations: matters which are often considered academic and therefore neglected.

The practical bearing of the 'solubility product' is adequately dealt with in Chapter i., and the usefulness of this part of the work is increased by inclusion of tables of solubility products in the appendix. Chapter vii. deals with so much of adsorption phenomena as is required for the purpose of discussing the question of 'dragging down' by precipitates resulting in errors near the equivalence point. This part naturally leads up to the work of Fajans, Taylor, and others on adsorption indicators, and adsorption of ions by precipitates. The 'titration error' arising from the relative insensitivities or sensitivities of indicators is dealt with quite fully for precipitations and neutralisation reactions. Addition and condensation products are considered, perhaps not so fully as they deserve. A section on stability of stock solutions will be found useful in practice. Readers will be grateful to the author for putting into their hands in one volume a much-needed discussion of the essentials of volumetric analysis.

J. J. F.

Diamond: a Descriptive Treatise. By Dr. J. R. Sutton. Pp. xii + 118 + 36 plates. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1928.) 15*s.* net.

FOR many years Dr. Sutton has devoted himself to the study of the diamond from various points of view, and in this book he has brought together the results of his painstaking observations. The language used is as simple as is possible consistent with scientific treatment, and the book should prove of great interest to the general reader as well as to the mineralogist. With regard to crystallography, the point is emphasised that the almost universal form is the octahedron, rarely the cube, and that nearly all crystals are really octahedra, more or less disguised; the idea that the funda-

mental form is really the tetrahedron is rejected. Evidence from X-ray examination seems to show that the structure is holohedral. This discussion of structure is illustrated by some very good photomicrographs, and by a great number of pencil drawings, which might have been made a little darker with advantage.

On that highly controversial subject, the origin of the diamond, Dr. Sutton concludes that the crystals produced in Moissan's famous experiment were not diamonds at all: with this conclusion most people will probably agree. He points out that the majority of crystals do not show any evidence of early free crystallisation from the magma, but quite the reverse: he thinks they were formed as a late constituent on the margins of eclogite xenoliths, at first as plastic crystals, becoming solid later and growing by successive superposition of similarly plastic shells on the nuclei thus formed, and the temperature at the time of formation must have been comparatively low. This conception of plastic diamond is a difficult morsel to swallow. R. H. R.

A Text-book of Systematic Botany. By Prof. Deane B. Swingle. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiii + 254. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 10*s*. net.

THERE are too few text-books that present the subject of taxonomy as other than a system of pigeonholes, and a work which aims at outlining its more philosophic aspects is welcome. The subject matter of Prof. Swingle's book is divided into two sections, of which the first, occupying rather less than one-half of the text, is devoted to a consideration of the principles and methods of taxonomy. The second section treats of some sixty families of seed-plants selected on the basis of their importance. The treatment of these latter is somewhat cursory and follows conventional lines. The omission of a consideration of the affinities of the selected groups indicates that their inclusion has scarcely been utilised to elucidate the principles dealt with in the previous section. With regard to this latter, there is much to be commended, but even here sufficient thought has not been devoted to the needs of the student. A knowledge of general botany is assumed, but where terms are defined these should at least be helpful. The statements that "a variant is a form arising by variation" and that "a mutant is a form arising by mutation" will scarcely assist the uninitiated, whilst the use, in this general manner, of the term 'form', which has a definite technical connotation in taxonomy, is at least unfortunate.

How to Enjoy the Starry Sky. By Marcus Woodward. (People's Library.) Pp. 238 + 8 plates. (London: Hodder and Stoughton, Ltd., 1928.) 2*s*. 6*d*. net.

THIS book differs from most popular books on the stars, both in purpose and style. It makes no attempt to explain the elements of astronomy, aiming rather to surround the celestial bodies with interesting associations of a literary or legendary character, thus arousing an interest in the subject which may lead to personal observation and the perusal of other books. Apart from three short chapters on the moon, planets, and comets, the greater part of the book is concerned with the constellations. The more important are described in turn, illustrated by a series of drawings representing the traditional figures, and in many cases the meanings of the star or constellation names, as well as legends connected therewith, are given. Interesting quotations from literary sources, and popular beliefs, superstitions, or quaint sayings, form a prominent feature in addition to a certain amount of astronomical information concerning the principal stars or other objects found in each constellation. The whole forms a very readable book, which can scarcely fail to interest and amuse the more advanced as well as the beginners for whom it is intended.

Three Minute Talks about Children. By Estelle Cole. Pp. 64. (London: The C. W. Daniel Co., 1928.) 2*s*. 6*d*. net.

IN this unpretentious little book Dr. Cole discusses some of the family relationships and shows the effect on the child of his mental environment. People are apt to forget that, although the material environment may be the same for each child in a family, there is one factor that can never be the same, namely, the position in the family with regard to the others. Here is described the problem of the only son, the middle child, the baby. Different types of behaviour ranging from the over-good to the extremely difficult are illustrated and diagnosed and the advice offered is expressed in simple terms.

The articles are all short and to the point, and if, by reading them, intelligent parents can be led to look at home conditions sometimes from the point of view of the child, a very valuable change of point of view will have been achieved. It is almost inevitable with such a form of presentation that some of the problems will seem too easy and some generalisations too sweeping, but the booklet should nevertheless prove very useful.

Principes et formules de l'hérédité Mendélienne. Par Prof. L. Blaringhem. Pp. xiii + 195. (Paris: Gauthier-Villars et Cie, 1928.) 40 francs.

THIS book gives a general account of the modern work on Mendelism, with particular reference to cultivated plants such as flax, peas, and barley. It is divided into three sections: (1) Mendel's laws and their applications; (2) mosaics and the linkage of characters; (3) formulæ, tables, and corollaries. The last is perhaps the most useful, as it brings together in summary form the various mathematical developments of Mendelism, including some of the methods and formulæ of Johannsen, Jennings, Pearl, and others for determining the results of different systems of crossing and of inbreeding, sex-linked inheritance, etc. The earlier part enters into details of the interpretation of Mendel's original experiments. Another chapter is on 'nuclear mosaics' (crossing-over) in *Drosophila* (spelled *Drosophyla* throughout).

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Connexion between the Absorption Spectrum of Hydrogen and the Many Lined Spectrum.

IT will be recalled that Dieke and Hopfield showed that the absorption bands of H_2, which are located in the extreme ultra-violet (about 1000-1500 A.), were due to transitions up from the ground level of H_2, which they called A, to two higher electronic levels which they called B and C respectively. Two years ago I found the emission bands in the visible which go down to the B, or $2\ ^1S$, level. In a series of papers (*Proc. Roy. Soc.*, A, vol. 123, pp. 54, 466; vol. 124, pp. 50, 69; vol. 125, p. 23; 1929) Dr. Davidson and I have been able to show that these bands comprise a large number of distinct band systems and contain a very large part of the total strength of the visible emission spectrum of H_2. Various attempts have been made from time to time to discover bands in this spectrum which end on Dieke and Hopfield's C level, but, until recently, nothing at all convincing has resulted from these efforts.

I have now found a number of band systems which end on this C state. These systems all have initial states which are identical with one or other of the initial states of the bands ending on the $2\ ^1S$ level. Most, though not all, of the bands are weak, but there is no doubt about their authenticity as the frequencies of the lines are connected by combinations which are known with great accuracy. The initial levels from which the transitions arise are those denoted by Richardson and Davidson as $4\ ^1A$, $4\ ^1B$, $4\ ^1C$, $4\ ^1\chi$, $4\ ^1E$, $3\ ^1A$, $3\ ^1C$, and $3\ ^1O$. Possibly $3\ ^1K$, $3\ ^1L$, $3\ ^1N$, and ^1Q may have to be included in this list, but there seem to be no bands coming from $4\ ^1\Psi$, $3\ ^1B$, and $3\ ^1M$. So far as they have been investigated, the band systems have the character of band sequences similar to those of the α, β, and other systems ending on $2\ ^3S$ rather than the progressional character of the bands ending on $2\ ^1S$. The bands which arise from the initial states to which the electronic quantum number 4 has been assigned lie in the green, the others in the infra-red.

The bands all have P', Q, and R' branches, but these are not equally developed. Most of them resemble the α, β, etc., bands in having the Q branches strongest, R' intermediate, and P' weakest, but the bands starting from $4\ ^1E$ have R' stronger than Q. The lines in each band have an alternation in intensity corresponding to a ratio in the weights of the alternate states of about 3 to 1. The stronger lines are $Q2$, $Q4$, $R'3$, $R'5$, $P'3$, $P'5$ in my numbering, which is one unit higher than that used by Hori and others. The transitions are governed by the same exclusion rules as operate in the other band systems of H_2. The doublet differences due to the non-coincidence of the R' P' with the Q final levels increase rapidly with rotational energy.

The final term differences, both vibrational and rotational, agree with those of Dieke and Hopfield's C level to the accuracy of the ultra-violet data, and the analysis of the final level confirms the correctness of Hori's analysis of the Werner ($C \longrightarrow A$) bands. This is important for several reasons, but I shall mention only one. It shows that this C level is something different from the initial level of Richardson and Davidson's infra-red bands. This initial level is quite distinct from the final level of the α, β, etc., bands, and both these levels have total (electronic) quantum number 2. There is also in the initial level of the bands originally called $3\ ^3S \longrightarrow 2\ ^3S$ by Richardson and Das what is almost certainly another 2 level. We thus have certainly 4, and probably 5, 2 levels in the spectrum of H_2. It is impossible, on any accepted principles, to classify all these 2 levels as singlet levels (or all as triplet levels). I therefore think that these new results greatly strengthen my view that the α, β, etc., and the $^3S \longrightarrow 2\ ^3S$ bands should be assigned to the orthohelium-like (triplet) systems, and all the other known band systems to the parhelium-like (singlet) systems.

I think it probable that the following classification of a number of the more important levels will turn out to be correct: *Parhelium-like* (*singlet*) *levels.* $A = 1\sigma\ ^1\Sigma$, $B\ (= 2\ ^1S) = 2\pi\ ^1\Sigma$, $C = 2\pi\ ^1\Pi$ (= final level of present systems), infra-red $= 2\sigma\ ^1\Sigma$, $3\ ^1O = 3\sigma\ ^1\Sigma$, $3\ ^1C = 3\delta\ ^1\Sigma$, $3\ ^1A$ and $3\ ^1B = 3\delta\ ^1\Pi$, ^1Q and the progressions about $\lambda 4200 = 3\delta\ ^1\Delta$, $4\ ^1E = 4\sigma\ ^1\Sigma$, $4\ ^1C = 4\delta\ ^1\Sigma$, $4\ ^1A$ or $4\ ^1B$ (possibly both) $= 4\delta\ ^1\Pi$, $4\ ^1\chi = 4\delta\ ^1\Delta$. *Orthohelium-like* (*triplet*) *levels.* Lower levels of α, β, etc., bands $= 2\pi\ ^3\Sigma$, upper levels of these bands $= m\pi\ ^3\Pi$ ($m = 3$, 4, etc.), upper levels of the $^3S \longrightarrow 2\ ^3S$ (or $^3S' \longrightarrow 2\ ^3S$) bands $= m\sigma\ ^3\Sigma$ ($m = 2$, 3). It would take too much space to defend this classification in detail, but a complete account of these systems and the conclusions to be drawn from them will be published elsewhere. For other views, reference may be made to a recent communication in NATURE by Dieke (June 29, 1929, p. 979) and to articles in the *Zeitschrift für Physik* by Weizel and by Finkelnburg and Mecke. It may be permissible to add that the number of established electronic levels in H_2 is now about forty.

O. W. RICHARDSON.

Relationship between h, c, and e^2.

I HAVE been trying to find experimental or indirect evidence bearing on Prof. Eddington's suggestion (*Proc. Roy. Soc.*, Jan. 1929) of the relationship

$$\frac{ch}{2\pi e^2} = 136. \quad . \quad . \quad . \quad (1)$$

For six quantities such as the six fundamental quantities c, e, h, G, m, and M (the 'mass' of the proton), I find that the *a priori* chance of there being a non-dimensional product or quotient of any three or less of the quantities, of which one may be raised to the second power, is between 1 : 1 and 1 : 5. Two such products are, however, found, namely, ch/e^2 and M/m. Further, assuming the approximate order of magnitude of the six quantities, the chance of a product chosen at random falling between 2000 and 1/2000 in value is about 1 : 7. But the values found are 860 and 1840 approximately. It is not, therefore, easy to attribute these results to chance.

On the other hand, if the non-dimensional constants 860 and 1840 are like those that usually occur in physics, I have shown (*Phil. Mag.*, April 1929) that they are only to be expected once in about 860 and 1840 such constants, respectively. Amongst 1125 constants I have only found one so large as 316; and the only case that I remember comparable with those now considered is the Reynolds number referring to flow through a straight tube just ceasing to be turbulent. The magnitude of the numbers is illustrated by the complexity of the suggestions $2\pi(|5 + 2^4) = 2\pi\ .\ 136$; and $(1^2 + 2^2 + 2^2 + 3^2 + 3^2 + 4^2)^2 = 184\bar{9}$ (see Enos E. Witmer, NATURE, Aug. 3, p. 180).

Apart from the experimental evidence given by Millikan's work, tending to show that the number in equation (1) is not exactly 136, there is similar evidence given by Bohr's theory for the Balmer series. Thus, writing Rydberg's constant for hydrogen

$$1{\cdot}0968 \times 10^5 = \frac{2\pi^2}{c(1 + m/M)(e/m)} \cdot \frac{e^5}{h^3} \quad . \quad (2)$$

(e being in e.s.u.), and eliminating h between (1) and

(2), the product of e/m and e should be obtained very accurately, as the errors in the values of Rydberg's constant, c and $(1+m/M)$ are very small. This product corresponds to pairs of values such as

$$\left.\begin{array}{ll} e/m \text{ (e.m.u.)} & 1{\cdot}776 \times 10^{7} \\ e \quad \text{(e.s.u.)} & 4{\cdot}867 \times 10^{-10} \end{array}\right\} \text{ or } \left\{\begin{array}{l} 1{\cdot}797 \times 10^{7} \\ 4{\cdot}810 \times 10^{-10} \end{array}\right.$$

But evidence that e/m is not appreciably larger than $1{\cdot}776 \times 10^{7}$ is given by *each* of the following :

(i) deflection of streams of electrons ;

(ii) the Zeeman effect ;

(iii) e/M for the hydrogen ion in electrolysis, together with M/m from comparison of the Balmer and Fowler-Pickering series.

Similarly, evidence that e must not be assumed appreciably larger than $4{\cdot}810 \times 10^{-10}$ is given by *each* of the following :

(iv) the charge on an α particle ;

(v) equation (1) together with h/e deduced from the photoelectric effect and from black-body radiation ; as well as

(vi) e (Millikan).

This indicates that one of equations (1), (2) is in error ; but the agreement of (i) and (ii) with (iii) tends to confirm equation (2), and hence throw the doubt on equation (1).

W. N. BOND.
Department of Physics,
University of Reading, Aug. 19.

Heat of Adsorption of Oxygen and Nitric Oxide on Charcoal.

MARSHALL and Bramston-Cook (*J.A.C.S.*, **51**, 2019 ; 1929) have measured the differential heat of adsorption of oxygen on activated charcoal and conclude that the heat of adsorption approaches a maximum value of 89,600 cal. per gm. mol. of oxygen as the amount of gas adsorbed approaches negligible dimensions. They refer to the work of Garner and McKie (*J. Chem. Soc.*, **130**, 2451 ; 1927 ; cf. Far. Soc., 461 ; 1926), who found at low surface concentrations a heat of adsorption of 5000 cal./mol., and observed that the heat rose to a maximum value of 71,000 cal. as the surface concentration of oxygen increased and then fell off at still higher concentrations. These values were given by an experimental arrangement in which a thermocouple was embedded in the middle of a mass

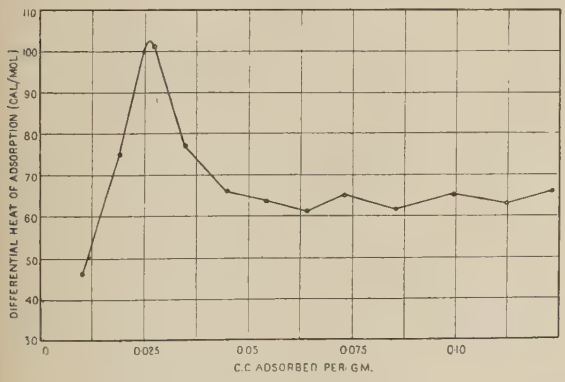

FIG. 1.—Oxygen adsorbed on charcoal at 20° C.

of charcoal. Marshall and Bramston-Cook suggest that it is desirable to repeat this work with thermocouples placed at different points throughout the charcoal.

During the last two years, the work of McKie has been repeated, and in the course of the research measurements similar to those suggested have been made. These have brought to light the fact that at high vacua carbon is relatively a bad conductor, and have also shown that at low oxygen concentrations the gas did not distribute itself uniformly throughout the mass of the charcoal grains. On this account, the vacuum calorimeter employed by McKie was made adiabatic, thereby preventing loss of heat from the calorimeter during measurement. Under these conditions, two thermocouples, the junction of one placed in the middle and that of the other placed on the outside of the mass of charcoal, gave the same rise in temperature. With this apparatus, the curves in Figs. 1 and 2 have been obtained for the differential heats of adsorption of oxygen and nitric oxide respectively on charcoal.

In these experiments, 0·007–0·010 c.c. of gas per gram of charcoal were added at a time. For oxygen

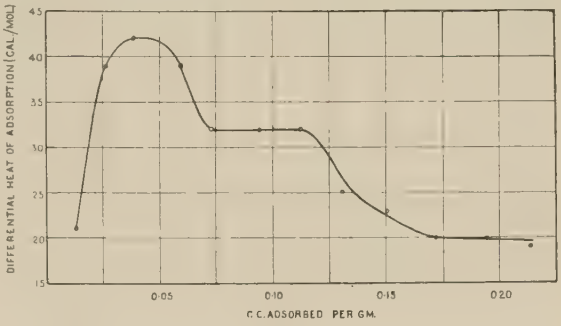

FIG. 2.—Nitric oxide adsorbed on charcoal at 20° C.

adsorbed on charcoal, the heat rises from 46 cal./mol. to 100 cal./mol. by the third admission and then falls to 65 cal., at which value it remains constant except for a curious type of alternation. The maximum occurs when 0·025 c.c. of oxygen per gram of charcoal had been adsorbed. This maximum shifts after long-continued heat treatment at 950° C. to lower surface concentrations. The American authors in their measurements added 0·03 c.c. oxygen per gram charcoal at a time, so that their surface concentrations were greater than ours. Also they gave the charcoal a preliminary treatment at 1000° C. for 60 hours.

For the same charcoal, the maximum heat of adsorption of nitric oxide occurs at somewhat higher surface concentrations than for oxygen. The alternation beyond the maximum does not occur for nitric oxide. There is a definite step on the curve indicating the presence of areas of different activities on the charcoal surface.

Kistiakowski and Taylor (*J.A.C.S.*, **49**, 2200 ; 1927) have observed similar maxima on the curves for the differential heats of adsorption of hydrogen on metals. We have not been able to observe the effect in the reaction of oxygen with finely divided copper, but this may be due to the fact that the surface concentrations employed were too high. With oxygen on copper, the maximum heat occurs at the lowest surface concentrations used.

The maximum value for the heat of adsorption of oxygen on charcoal which was obtained for single admissions of gas occurs when 0·12 c.c. oxygen is added per gram of charcoal. The value, 89 cal., agrees with that of Marshall and Bramston-Cook. The value obtained probably depends on the nature of the charcoal.

It is difficult to decide whether the above phenomena are due to activation of the carbon surface or to incompleteness of the reaction between oxygen and carbon at low surface concentrations. The experimental evidence is, however, in favour of the latter hypothesis.

H. I. BULL.
W. E. GARNER.
University, Bristol, July 30.

Natural Selection.

THE confusions and obscurities in Prof. MacBride's recent letter (NATURE, Aug. 10, p. 225) may perhaps excuse some of us if we pause awhile before giving up the "facile truism" of natural selection.

(1) Prof. Poulton did *not* "quote *in extenso* a letter from Darwin to the distinguished American botanist Asa Grey", but two short extracts from the concluding chapter of "The Variation of Animals and Plants under Domestication" which had accompanied it (NATURE, June 8, p. 874). For Prof. MacBride to have been "well acquainted" with the substance of those quotations before writing his first letter (NATURE, May 11, p. 712), he must have read it, and with some attention, in the original, where it occupies nearly a page in Chap. xxi. and more than a page in Chap. xxviii. Inadvertence is no crime, but it is worth noting that Prof. MacBride does not always verify his references, and is liable to lapses both of memory and of pen.

(2) Natural selection, it will be remembered, was compared by Darwin to a man building an edifice, not of cut stones, but by selection from the varied fragments of rock at the base of a precipice. Prof. MacBride terms Darwin's analogy "false" and his reasoning "thoroughly bad"—false, because Darwin's organic variations were fortuitous, while the variations of stones are "definite", as may be seen by comparing a scree of Harlech grits with one of Llanberis slates. Having a critical mind, Prof. MacBride will at once recognise his mistake in this illustration. Darwin's metaphor dealt with the stones beneath one precipice, not two; and in any one scree, as Prof. MacBride noted, the stones are mostly of one type, with the characters due to fracture from one kind of rock,—grit or slate, say, but not both together. The variation in the shapes and sizes of the stones is thus homotypic and fortuitous, and obeys the laws of chance, as Darwin assumed. Prof. MacBride's illustration would be valid only in a comparison between the variations of two different types of animals, say herrings and sea-urchins; but Darwin was illustrating an act of evolution, which involves only the variation of one type.

(3) Darwin's analogy is also falsified, according to Prof. MacBride, by another discrepancy, since house-building involves "psychic factors" ("purpose", "end", "ideal"), whereas his theory of evolution did not. All metaphors, of course, have their limits of application, but in this case the objection is groundless, since Darwin only used his metaphor to illustrate the relations of selection to the raw materials of variation. From his point of view the psychic outfit of the builder could be ignored. The building operations of an arenicolous foraminifer or of a caddis worm would have suited him almost as well but for their relative unfamiliarity (cf. the simpler version in Chap. xxi. of "Animals and Plants").

(4) "Natural selection", says Prof. MacBride, merely means "the survivors survive" (loc. cit., May 11): the idea of a differential death-rate, which discriminates between the possessors of different "variations", is "definitely not true". To obtain this result, however, it is first of all desirable to rule out of consideration all "ill-adapted types" as belonging "not to the *natural*, but to the *pathological*" (Aug. 10). The new philosophy, it thus seems, is frankly Procrustean.

(5) Yet, in spite of all this, Prof. MacBride goes on to say, "natural selection is a reality". He is convinced of its reality because for seventeen years he has "raised annually thousands of larvæ of the same species". Presumably he has witnessed a heavy mortality in his pots. "But what is 'selected'", he says, "is not the 'random' variation, but . . . 'the most plastic individual', that is, the one which reacts best to the environment; in other words, *the most vigorous*." Prof. MacBride has been severe with others for their "unsupported assumptions", but who can tell what a torrent of pungent epithets he would have poured over this remarkable passage if he had found it in the writings of Darwin, Poulton, or any other prominent advocate of Darwinian selection? There is just the possibility, however, that it is an elaborate joke, and means: "Even under the superlative conditions of my own rearing jars, natural selection insists on remaining a truism." If, on the other hand, it is to be taken seriously, one may perhaps ask Prof. MacBride how he knows that the survivors were the "most plastic" individuals, which reacted best to the environment. A word or two also on the nature of the 'reactions' would be welcome.

(6) Prof. MacBride characterises the mental attitude of Darwin and his family towards natural selection as an example of the error due to the "reification of words". After his latest pronouncement it seems just a little doubtful whether the "verbification of things" really offers the prospect of a more fruitful gospel.

WALTER GARSTANG.

Leeds, Aug. 24.

Nature of the Rickets-producing Factor in Cereals.

WE have become used to the idea that rickets is a vitamin deficiency condition, and yet there are several facts which militate strongly against complete acceptance of this hypothesis. The most important consideration is the fact that rickets can be produced experimentally by feeding with excess of cereals. It will be remembered that before the demonstration that rickets could be induced in puppies by a diet devoid of what we know now to be vitamin D, one theory of the etiology of rickets in infants attributed the disease to the well-known excessive carbohydrate (or, to be more accurate, cereal) intake of the children.

E. Mellanby, Holst, and Green and Mellanby have followed up this interesting observation, and their recent investigations have shown even more conclusively that typical rickets can be induced in growing puppies and rats by feeding with excess of cereals, or by adding extracts of cereals to a diet which does not produce rickets in control animals. The cereal employed was mostly oatmeal, but wheatmeal, rice, barley, maize, white flour, wholemeal flour, and peas were also found to have the same anti-calcifying effect, although not to the same extent.

As to the nature of the substance that is responsible for this effect, there has been much speculation. It is not the contained starch or the salts, and it had been concluded that it is an 'anti-vitamin' present in small amounts in the cereals, thermostable, dialysable, but destroyed by prolonged boiling with acid. The great stumbling-block to investigation has been the mechanical difficulty of the extraction of the cereals.

In my experiments I first evolved a simplified method of extraction. In short, the process consists of boiling the oatmeal with one per cent hydrochloric acid for some hours, then evaporating the solution to a small bulk, and dialysing against distilled water; the dialysate is evaporated to dryness and then extracted with 95 per cent alcohol; the alcohol is evaporated off and the final residue is dissolved in water and is ready for injection into animals. I then set out to investigate what action the cereal extract has on the blood calcium level. After prolonged investigation, I am able to report that cereals—or at least oatmeal, as most of my work was done on oatmeal—contain a substance which when injected into

rabbits lowers the blood calcium. The character of the response of the blood calcium level is the same as I previously found to be the case for extracts of bovine ovaries, namely, a lowering of blood calcium of about 30-35 per cent usually in twenty-four hours and a return to normal in about forty-eight hours. In all respects the type of response was exactly the same as that recorded in the case of ovarian extract.

It would thus appear that the substance which has the anti-calcifying action has the same action on the blood calcium as the ovary. One can therefore assume that the mode of action of this 'anti-vitamin' is simply by reducing the blood calcium; hence the observations of previous investigators that this action of cereals can be counteracted quantitatively by administering either calcium salts or vitamin D, both of which act by raising the blood calcium. From the work of Robison and his associates we know that the bone enzyme or phosphoric esterase occurring in ossifying bone is quite adequate in rickety bone, but faulty ossification in rickets is apparently due to insufficient concentration of calcium or phosphorus or both in the blood.

The implications of this finding are many and varied and are fully discussed in the paper appearing shortly, which contains a full report of this work. The most important result is that rickets cannot be conceived to be purely a vitamin deficiency condition, but is primarily and ultimately due to a lowering of the blood calcium. This lowering of the blood calcium (and a low blood phosphorus is most probably secondary to it) can be produced by lack of vitamin D, by the administration of cereals, or by a faulty calcium to phosphorus ratio in the diet. Actually, rickets may yet prove to be a manifestation of hypoparathyroidism in young growing animals. If that is the case, our present conception of the rôle of vitamin D and probably of the other vitamins will have to change very appreciably.

L. MIRVISH.

Department of Physiology,
Medical School,
University of Cape Town,
July 18.

Vitamin B.

IN recent work Dr. Vera Reader (*J. Soc. Chem. Ind.*, **47**, 1247; 1928) has found that at least two thermolabile vitamin B factors are necessary for the nutrition of the rat, in addition to the factor or factors supplied by alkaline autoclaved marmite. Proof of these three 'B' factors has been made possible by the use of concentrates prepared from baker's yeast by the extended method of Kinnersley and Peters (*Bioch. J.*, **22**, 419; 1927), in which the process was carried through to the alcohol stage. These concentrates contain B.1, and are highly curative to the pigeon, but when given to rats in large amounts (up to 8 pigeon doses per diem), they do not supplement completely alkaline autoclaved marmite (pH = 9·0 for 1 hour at 120° C.). The latter contains the thermostable so-called anti-pellagra factor. These facts dispose of any objections raised in a recent paper (Aykroyd and Roscoe, *Bioch. J.*, **23**, 493).

The three factors in question are present in fresh marmite. I have found that fresh marmite in the presence of casein and cod liver oil does not lead to resumption of maximum weight in adult pigeons fed upon polished rice. As I have confirmed the finding of Williams and Waterman (*J. Biol. Chem.*, **78**, 311; 1928), that increase to a maximum weight readily takes place upon a whole wheat diet, the factor discovered by Dr. Reader is not the same as the thermolabile factor of Williams and Waterman. In so far as it is thermolabile, it would also appear to differ from that of Hunt (*J. Biol. Chem.*, **79**, 723; 1928).

I am directing attention to these facts here because of their importance to workers in this field. It should be realised that *at least* five 'B' factors have now been described: (1) the original thermolabile, anti-neuritic, curative to pigeons; (2) a second thermolabile (V. Reader); (3) a thermostable factor present in alkaline autoclaved marmite (anti-pellagra, Goldberger, etc.); (4) a second thermostable factor described by Hunt; together with (5) the 'Williams and Waterman' factor. The importance of the latter has at present been demonstrated only in pigeons. According to the exact conditions of the tests, some of these factors must have been included as either B.1 or B.2 in much of the previous work.

RUDOLPH A. PETERS.

Department of Biochemistry,
Oxford, July 29.

Adsorption of Water by Wool.

IN the current number of the *Transactions* of the Faraday Society (**25**, 451; 1929), Mr. A. T. King discusses the changes produced by stretching in the hygroscopic capacity of single wool fibres. Although of a different nature and carried out for a different purpose, the following independent experiments seem to provide an answer to some of the inquiries raised by Mr. King's paper.

I have shown in previous papers that when wool fibres are held stretched in water, the fibrillæ within the cells undergo plastic flow and take a permanent set. It seemed probable that the affinity of the fibrillar structure for water would be increased by the disorganisation of its crystal structure and the question was examined in the following manner. Two consecutive 5-centimetre lengths were cut from a single wool fibre, one of these being kept stretched 30 per cent of its length in water at 25° C. for twenty-four hours, so as to occasion the maximum possible plastic flow of the fibrillar structure. At the end of this time the fibre was released and allowed to return to its original length. The other 5-centimetre length of fibre was simply immersed in water at 25° C. for twenty-four hours without stretching. A sufficient number of fibres were treated in this way to provide ultimately about 30 milligrams of both types of material. I have shown that no rupture of fibrillæ occurs in single wool fibres if these are not stretched beyond 30 per cent of their length, so that the only difference between the two samples was that in one case the fibrillæ had undergone plastic flow, whereas in the other case they remained completely unaltered.

The amounts of water adsorbed by the two samples were determined at a number of different humidities

Relative Humidity (per cent).	Percentage of Water adsorbed by:	
	Untreated Wool.	Stretched Wool.
63·3	14·31	14·44
92·5	24·92	25·77
100·0	..	..
75·0	17·92	18·95
34·2	9·53	10·24

by suspending them from a quartz spiral balance over sulphuric acid solutions of the required strength in a constant temperature room (22·2° C.). Each sample was taken from absolute dryness up to saturation in stages, and then in the reverse order to dryness, so that the values given in the accompanying table correspond

with true adsorption and desorption processes. The amount of water adsorbed at 100 per cent relative humidity is not indicated because of the difficulty in preventing actual condensation of water on the wool. In every instance the amount of water adsorbed by the wool which had been stretched was greater than that adsorbed by the untreated sample, and it seems clear that plastic flow in the fibrillar structure alone will increase the affinity of wool for water.

J. B. SPEAKMAN.

The University,
Leeds,
Aug. 14.

The Adsorption of Organic Acids by Charcoal.

IN the recent issue of the *Proceedings of the Royal Society* (A, **124**, 554; 1929), H. J. Phelps and R. A. Peters, while studying the adsorption of some organic acids on pure charcoal as a function of the hydrogen ion concentration, come to the conclusion that, in the given conditions, the non-dissociated molecules and not the corresponding anions are adsorbed. This conclusion is based on similar observations to those already made by R. Wurmser and myself some years ago (*C.R.*, **179**, 972; 1924) with another charcoal, that, while for different acids there is no relation between adsorption and dissociation, in the case of the same acid, there is a very definite relation between these two phenomena; and I am very glad to see our results confirmed and enlarged by the interesting work of Messrs. Phelps and Peters.

May I now recall that, in another communication published in the same year (*C.R.*, **179**, 1404; 1924), which seems to have escaped the attention of the authors, I was able to give a definite proof of the selective adsorption of non-dissociated molecules by the charcoal used. Having previously determined (spectrographically) the sum *molecules + possible anions* adsorbed, I measured the electrical charge acquired by the charcoal particles after adsorption, and found it completely independent of the quantity and of the nature of the adsorbed acid, the data being of course reduced to the same hydrogen ion concentration. It seems, therefore, that this is the best proof of the electrical neutrality of the adsorbed substance.

It is easy to see that this result, of course, does not exclude the possibility of electric forces playing a rôle in that type of adsorption phenomena, when one recalls that the molecules adsorbed here are dipoles which are liable to be affected by electrostatic forces (cf. V. Henri, "Structure des molécules").

CLAUDE FROMAGEOT.

Kaiser Wilhelm Institut für Biochemie,
Berlin-Dahlem.

Anomalous Diamagnetism.

IN a letter in NATURE of June 22 (p. 945), reference was made to the Ehrenfest hypothesis which ascribes the high diamagnetic susceptibility of bismuth to the existence of closed electron orbits of larger than atomic dimensions in association with the crystal lattice.

It may be pointed out that the existence of such orbits appears to furnish a very natural explanation of a variety of phenomena which up to now have been obscure. In the first place, the extremely pronounced diamagnetic anisotropy characteristic of bismuth (and also of graphite) becomes immediately intelligible as a consequence of the specific orientation of the assumed electronic circulations within the crystal lattice. Further, the large Hall effects and changes of electrical resistance exhibited by bismuth and graphite when placed in a magnetic field become comprehensible, since the electronic circulations would be modified by the field, and result in corresponding modifications of the flow of electricity through the substance under a simultaneously impressed electromotive force. There would be every reason to expect, as is indeed the case, that the magnitudes of the Hall effect and the change of resistance would depend on the orientation of the crystal in the magnetic field and the direction of flow of electricity through it.

Then again, with rise of temperature and consequent thermal derangements of the lattice, the postulated electronic circulations would tend to disappear and give place to chaotic electronic movements. The diamagnetic susceptibility would then diminish towards its normal value for a non-crystalline condition of the substance, and corresponding changes would occur in the coefficients of the Hall effect and magnetic variation of electrical resistance. That liquid metals do not, so far as I am aware, exhibit a measurable Hall effect is significant in this connexion.

In close analogy with the influence of temperature, and presumably to be explained on very similar lines, is the remarkable fact that the anomalous diamagnetism of bismuth and of graphite tends to diminish or disappear when the substances are reduced to a colloidal condition.

Finally, it may be remarked that the dimensions of the crystal lattice cannot be uninfluenced by the existence of such regular electronic circulations within it or by modifications produced in them by an external agency. That the magnetostriction of bismuth in strong fields discovered by Dr. Kapitza (NATURE, July 13, p. 53) is connected with the anomalous diamagnetism of the substance admits of little doubt. The notable increase in magnetostriction at low temperatures observed by him appears to fit in very well with the Ehrenfest hypothesis.

C. V. RAMAN.

Dew: Does it Rise or Fall?

MESSRS. E. E. Free and Travis Hoke begin Chapter xiii. of their recent work on "Weather" (Constable and Co., 1929) by stating that "the chief thing to be said about dew is that it doesn't fall, early or late, on Maxwelton or any other braes. In fact it rises." They go on to explain that dew is formed when the warm, moist "breath of the ground" comes in contact with colder objects, such as leaves, twigs, or spider webs, causing precipitation. They make no note of the fact that dew is formed only under a clear sky which allows free radiation of the earth's surface heat; but they make the following surprising statement: "Most of the dewdrops on leaves and blades of grass, especially leaves close to the ground, are on the under sides; that is, the side of the leaf or grass closest to the soil."

This was so widely at variance with the general impression I had received, that I went out on three dewy mornings to examine the herbage, and found, as I expected, that while the upper surfaces of leaves were heavily bedewed, the under surfaces were quite dry.

In stating that dew does not fall, but rises, the authors seem to be treating of dew before it is formed. It is true that the warm air radiated from the earth is charged with moisture, but that continues as vapour until it meets the cold night or morning air, when it is condensed and precipitated as dew. The vapour rises, but the dew can only be described as falling.

HERBERT MAXWELL.

Monreith.

Early Man in East Africa.

IT was inevitable that problems relating to early man and his culture should count largely in the proceedings of Section H (Anthropology) at the South Africa meeting of the British Association. Not only had the study made great strides locally since the Association last met there in 1905. Recent discoveries such as that of Rhodesian man and the Taungs skull had aroused intense interest which was bound to find expression. The meeting afforded European archæologists a unique opportunity to acquire first-hand knowledge of local conditions and to discuss them on the spot. In addition, the presence in Johannesburg of a number of visitors to the International Geological Congress made it possible to bring together a body of expert opinion on points depending upon geological evidence in conditions which it was improbable would recur.

Among the more important of the topics which had been announced for discussion was that of early man in East Africa, Mr. L. S. B. Leakey having undertaken to report upon the work of the East African Archæological Expedition in 1926–27 and 1928–29. It will be remembered that a preliminary report on the earlier season's work was presented to Section H of the British Association at the meeting in 1927. The work of the second season has confirmed, but at the same time has extended, the tentative conclusions based upon the earlier investigations in such a way as to necessitate a certain amount of revision in terminology and correlation. (A note of this revision appeared in a letter from Mr. Leakey and Mr. J. D. Solomon, geologist of the expedition, which was published in NATURE of July 6, p. 9.)

At the close of operations in 1927, three pluvial phases and one post-pluvial wet phase had been recognised, the latter connected with the 185 feet beach of Lake Nakuru, and Stone Age industries had been found associated with the second and third pluvial phases. Human remains were associated with the third phase, to which the name of 'Elmenteita man' had been given, and also with the post-pluvial wet phase of Nakuru. By the work of the second season, a still earlier pluvial phase, a number of earlier cultures and more human remains were revealed. Further, a gap in evidence was filled by the discovery of large collections of animal remains.

On the basis of these results, suggestions have been put forward as to their age, and a tentative correlation of the pluvial phases with the glaciations of Europe has been made. If this should be confirmed, it will establish a direct time relationship between the European and Central African Stone Age cultures.

The work of the Expedition has centred mainly around the chain of lakes which lie on the floor of the eastern branch of the Great Rift Valley from Lake Baringo in the north to Lake Magadi in the south, the central area round Lakes Nakuru, Elmenteita, and Naivasha being worked out in greatest detail. These lakes, now shrinking rapidly, in former times have been of considerable size and depth, as shown by the old lake beaches. They bear evidence of considerable climatic changes in times stretching back to the Pleistocene or possibly to the Pliocene.

As a result of fresh evidence, the nomenclature now suggested is as follows :

Old Name.	*New Name.*
Post-Pluvial wet	Nakuran. Makalian.
Third Pluvial	Gamblian.
Second Pluvial	Enderian.
First Pluvial	Eburrian.

The old first and second pluvials are considered minor phases of the same event, not separated by a period of aridity, but merely by a break in the pluvial conditions of the Enderian. The Eburrian corresponds to Prof. J. W. Gregory's Kamasia Sea, which that authority attributed to the Miocene, a view which Mr. Leakey does not accept owing to the occurrence in it of an Acheulean culture.

An association of cultures with these phases has been worked out. It is to be noted that Mr. Leakey employs a European terminology in preference to a localised nomenclature, but he puts in a caveat that, though based upon resemblance, no implication of contemporaneity is made thereby. It has to be borne in mind that the Kenyan cultures, owing to a difference of material, present variations which do not appear in the European cultures. With this reservation, the culture and pluvial sequences are associated as follows :—

Pluvials.	*Cultures.*
Nakuran	Kenyan Wilton. Nakuran.
Makalian	Elmenteitan.
(Late Gamblian)	Red-bed culture. (Mousterian influenced by Aurignacian.)
Gamblian	Upper Kenyan Mousterian. Upper Kenyan Aurignacian.
Enderian	Lower Kenyan Mousterian. Lower Kenyan Aurignacian.
Eburrian	Kenyan Acheulean.

In regard to this classification, it is to be noted that both Mousterian and Aurignacian occur at the base of the Enderian deposits, although only a very small series of Aurignacian types has been found. Right through the sequence the two co-exist side by side, but there is no sign of any fusion until the closing stage of the Gamblian in the Red-bed culture. This has close affinities with the Bambata culture of Southern Rhodesia and the Still Bay of South Africa. The most strongly developed Aurignacian is found in the lowest deposits of Gambles Cave II, the chief tools being backed blades of Chatelperron and Gravette type, burins and end- and keel-scrapers. The Elmenteitan is a localised development of the Upper

Kenyan Aurignacian without exact parallel in Europe, but with close affinities to Magdalenian. With it is associated a very fine pottery. The Nakuran is a culture contemporary with and closely allied to the Kenyan Wilton, so called from its resemblance to the Wilton industry of Southern Rhodesia. With it are stone bowls, pestles and mortars, and other evidences of agriculture, hut circles of stone without mortar, and a few beads of agate and faience said to resemble beads of Mesopotamia and pre-dynastic Egypt.

Fragmentary human remains and two whole skeletons have been found in Gambles Cave II associated with the Aurignacian culture. Unquestionably *Homo sapiens* and non-negroid, they show certain resemblances to the Elmenteita type which followed and was probably descended from them. The Elmenteita type, found in association with Elmenteita culture in 1927, is also non-negroid, though one skull, a female, shows definite negroid tendencies. On a Wilton site at Willey's Kopje, though not of proven makers of Wilton, were a number of skeletons of long-limbed negro type, but with several features distinguishing them from any modern negro series. The only complete skull from Nakuru is on the whole non-negroid, yet it has certain negroid characters. In certain respects it is said to recall skulls from Al-Ubeid, near Ur.

The fauna have not yet been worked out, but they include an extinct horse of Enderian date and an extinct water buffalo of Gamblian date. Dr. E. Reck, of Oldoway, considers the Enderian fauna equal to the Oldoway fauna, in which 50 per cent were extinct species, and associated with them was a skeleton of *Homo sapiens* almost certainly of the same race as Mr. Leakey's Gambles II.

As regards the correlation of the pluvial periods with the European time sequence, there is a strong probability that the glacial phases of Europe must have resulted in an increased rainfall in regions to the south. This may account for the pluvials of Kenya. It is therefore suggested that the Makalian should be compared with the Buhl Stadium and that the two major pluvial events should be correlated with the glaciations of Riss and Würm. However that may be, local evidence, such as the fact that the Eburrian series are faulted by the second main series of the Rift Valley faults, and that the Enderian series have yielded pleistocene animals, affords good grounds for considering the two main pluvials as Pleistocene events, possibly with the beginning of the first major pluvial in the Pliocene, the minor pluvial (Makalian), being at the close of the Pleistocene and beginning of the Holocene. Thus both Mousterian and Aurignacian can be considered as arriving in Kenya at the beginning of the second half of the Pleistocene.

It will not be out of place to refer at this point to a paper presented to Section H at Johannesburg on July 31, by Mr. C. van Riet Lowe, on the archæology of Sheppard Island and the Vaal Valley generally. Mr. Lowe's investigations have established three, and probably four, pluviations in South Africa, with three of which different palæolithic cultures are associated. In the First Pluvial, man practised a Lower Stellenbosch (true Chellean type) culture, as found in terraces 30-100 feet above present river level. In the Second Pluvial is Upper Stellenbosch (that is, Acheulean type) side by side with mammoth and *Archidiskodon Sheppardi* and *Archidiskodon Transvaalensis*. In superimposed lighter gravels are the remains of Fauresmith (La Micoque type) industry mixed with remains of Middle Stone Age of a distinct Mousterian flavour—the earliest arrival of the Mousterian which ultimately gave rise to pure Middle Stone Age industries practised throughout the country. Belonging to the lighter gravels are two extinct species, *Equus Capensis* and *Bubalus Bainii*—this latter the extinct water-buffalo found by Mr. Leakey in Kenya. A period of extreme aridity of considerable length preceded the Third Pluvial, in which appear folk of a true Neoanthropic type practising the industries of a Later Stone Age with marked Capsian-Aurignacian flavours. These overlie a heavy stratum of silt which covers the Middle and Earlier Stone Age remains. This deposit, which represents the most recent terrace of this type in the Vaal Valley, is most probably Pleistocene. Mr. Lowe, while holding it reasonably probable that these pluvials might be correlated with European glaciations, did not consider the time yet ripe for anything more than the most tentative of suggestions.

It is scarcely necessary to emphasise the significance of Mr. Lowe's contribution to the problem of early man in Africa in relation to Mr. Leakey's investigations. It must be evident that a great deal more investigation and reflection on the evidence already at hand is necessary before any conclusion can be formulated. That we have not yet attained any crucial evidence as to the place of origin of man's early cultures is obvious; yet, as always, it seems to point to the north, possibly to somewhere in the Saharan area, at this period not yet arid. In *Man* for July, Mr. Wayland of Uganda, who unfortunately was prevented by illness from taking any part in the discussions, inculcated caution in drawing conclusions from the Kenya evidence, and, while suggesting a rather later date than had previously been claimed for Nakuru man, looked tentatively to Miss Caton-Thompson's Fayum neolithic for a possibly contemporary, possibly even older culture.

The whole question, as was to be expected, gave rise to considerable discussion, and a committee appointed *ad hoc* held two sessions in which it was discussed and questions of terminology thrashed out. Of this no doubt more will be heard later. Some of the members have had the additional advantage that on their return they have visited Kenya and inspected the sites on which Mr. Leakey has worked. In a cable from the *Times* correspondent at Nairobi, published on Sept. 3, it is stated that Prof. H. J. Fleure has confirmed the conclusions as to the succession of deposits and agreed that the human remains are different from those of any of the modern population, while holding that the succession of cultures affords an extraordinary parallel with those of the Old Stone Age in Europe.

Science and Engineering.[1]

By Prof. F. C. Lea.

THE economic and beneficent importance of the work of the engineer is recognised by all, in the provision of safe, reliable, and efficient means of transport and in the wonderful harbours and docks which make possible the interchange of commodities between the nations; in the utilisation of sources of energy for doing the work of the world; in the equipment of factories and workshops with machines that produce abundantly so that the standard of life is raised; in supplying to communities pure water and in the disposal of sewage without danger to health or to the contamination of rivers and streams; in making it possible to plough the great spaces and gather the abundant harvests with little labour; in the provision of implements to combat the enemies of the fruit harvest and in the construction of dams and reservoirs to store the abundant rains for the time of drought so that even the barren places shall be fruitful and rejoice. For these achievements of engineering it is not difficult to obtain recognition, but it is often overlooked that engineering is affecting the intellectual outlook of peoples and by its very successes may introduce social and political problems of great significance.

It is not, however, desired in this address to emphasise the intellectual or political influences of engineering but rather to suggest: (1) the vital importance of scientific research to engineering; (2) that as in the remarkable engineering developments of the last century the scientific method has been the key to progress, even so it must be in the future; and (3) that there are many engineering problems of great interest and importance, not only to engineers but also to the general public, which can only be solved by supplementing experience by direct and indirect attack, using all the aids that mathematical and experimental science can give. It is also desired to suggest that all the arguments for a public interest in scientific research apply with particular force to the subject of engineering.

[To illustrate these three aspects of his subject, Prof. Lea touched upon many branches of engineering and scientific inquiry, ranging from ancient engineering as seen in Mesopotamia, Egypt, and Rome, to the pregnant researches of Carnot, Clausius, Froude, Reynolds, Rayleigh, Maxwell, Hertz, Fleming, Coker, Eddington, Einstein, Michelson, and Morley. "Upon almost every section of this Association", he said, 'engineering lays tribute, and in return engineering has given something at least to make possible much of the brilliant work associated with other sections". Only the precision of modern engineering has made possible the manufacture and control of great telescopes and other instruments by which the predictions of Einstein could be tested.

In the main, however, Prof. Lea kept to the important matters of prime movers, structures, aeroplanes and airships, materials and roads, all of which afford abundant testimony to the interdependence of engineering and abstract science. There were great bridges in ancient times, but such structures as the Forth Bridge, the Sydney Harbour Bridge, the Zambezi Bridge, and the Hudson River Bridge of 3500 ft. span, now in course of construction, were not possible before the birth of modern science and the scientific method. Neither was there a useful steam engine or other great and efficient prime mover before there came into the intellectual life of Europe that wonderful renaissance out of which modern experimental science was born.

Before Savery and Newcomen produced the first successful steam engine, many experiments on the pressure of the atmosphere, the relation between pressure and volume in gases and on the condensation of steam, had been made by Porta, Torricelli, Papin, Boyle and others. Watt's great improvement of the steam engine was surely not an invention in the ordinary sense, but a splendid deduction from the quantitative knowledge of the latent heat of steam obtained from his own experiments and those of Black. In the latter part of the eighteenth century and the beginning of the nineteenth, organised experiments on the flow of fluids were carried out, relative velocities, momentum, and kinetic energy were well understood, and the next step was made by Poncelet in 1832, who enunciated the guiding principles underlying the design of vanes receiving moving fluids, and from that time progress has been so remarkable that to-day water turbines of more than 70,000 h.p., having efficiencies greater than 80 per cent, are being constructed. The brilliant achievements in the development of the steam turbine of Sir Charles Parsons and others following in his steps are to-day well known.

At the beginning of the nineteenth century there were probably 10,000 engines in England, giving a total horse-power of about 200,000. To-day, steam turbines, each capable of developing 200,000 h.p., have been or are being made for stations in various parts of the world. It seems very doubtful if this could have been possible except as a consequence of the work of Poncelet and two centuries of scientific experiment.]

Prime Movers.

Though so much has been done in the development of prime movers, there is perhaps no movement in engineering to-day that is of greater interest, not only to engineers but also to the general community, than the attempts that are being made to increase considerably the efficiency of power production from coal and other fuels. The average overall thermodynamic efficiency of the public stations distributing electrical energy in Great Britain for the year ending March 1928 was about 15 per cent. The best station had an efficiency of 21·3 per cent. Recently a power unit has been supplied from England to Chicago which on test gave an efficiency of 34 per cent—a remarkable figure. Making allowance for boiler losses, efficiencies of from 25 to 35 per cent ought to be possible, therefore, in the future, and if only suitable materials can be developed to meet the onerous conditions of temperature, corrosion, and erosion, higher efficiencies than 35 per cent may be anticipated with steam plant. Still higher thermodynamic efficiencies may be expected, as

[1] From the presidential address to Section G (Engineering) of the British Association, delivered at Johannesburg on Aug. 1.

well as the chemical riches of the coals preserved, if, as a result of research, solid fuel engines or gas turbines can be developed.

At the temperature of from 400° F. (205° C.) to 600° F. (315° C.) at which boilers and super-heaters have until recently worked, mild steels have been found suitable. To realise higher efficiencies than at present, much higher temperatures will be required, and at contemplated temperatures of 1000° F. (538° C.) and upwards carbon steels creep at low stresses. Below a certain stress, at a particular temperature, which I have ventured to call 'the limiting creep stress', the creep ceases or becomes so small that it cannot be observed in, say, a number of days. This 'limiting creep stress' is evidently the important factor in the problem of high working temperatures. Experiments indicate that, with alloy steels, limiting creep stresses much higher than those obtained from carbon steels may be expected, and that alloys of iron, nickel, chromium, and with or without other alloyed elements, containing so much as 60 per cent of nickel and chromium, have considerable strength at high temperatures and also resist corrosion and erosion. There is still, however, a very large amount of research to be done in which the laboratory and the workshop must co-operate; as new workshop technique is required before these alloys can be used for specific purposes.

Structures.

The indebtedness of structural engineering to mathematics and to experimental science has already been suggested, but these powerful aids to progress had to be supplemented by the development of new materials and by a direct experimental attack before the remarkable achievements of recent times were possible.

In this respect it is well to go back occasionally to William Fairbairn, president of Section G of the British Association in 1862. He carried out his classical experiments during the forties of last century to determine stable forms of compression elements for structures, and upon his experiments practice followed rather slavishly for more than forty years. The failure during erection of the cantilever of the Quebec Bridge dramatically forced attention upon the problem of the stability of compression elements. Again a series of experiments filled the gap in knowledge and led to success.

Further work on a large scale, the cost of which can probably only be undertaken by public authorities, is desirable. During the last twelve years attempts have been made, with considerable success, to design all-metal aeroplanes and rigid airships, the compression elements and beams of which must of necessity be as light as possible. With a fair degree of precision the external forces can be determined by experiments upon models. The structure of an aeroplane has a certain degree of 'statical indeterminateness', but the forces and the bending moments in the elements can be approximately obtained, and what might be called the primary stresses can be found with the same degree of approximation.

Three serious difficulties, however, immediately faced the designers: (1) materials of a suitable character and in a suitable form for constructing the very light but strong elements; (2) the lack of technical skill and suitable machinery for building up the elements; (3) the lack of knowledge and the almost insuperable difficulty of determining by analytical methods the secondary, and what might be called stresses of even higher orders of indeterminateness. The only way was a courageous combination of experiment and mathematical investigation. One without the other was useless, but by a combination of the two rapid progress was made, and to-day all-metal aeroplanes are being constructed of steel or of duralumin which are as light, more durable, and stronger than the aeroplanes made of the best spruce.

There is still, however, a great deal to be done in connexion with structures, and the only hope of a satisfactory solution of many problems is not simply by accumulating experience, but by combining experience, experiment, and mathematical analysis in an endeavour to reduce the whole to definitely co-ordinated knowledge. Nearly thirty years ago I was privileged to assist with some experimental inquiries on the deflection of bridges produced by rapidly moving loads. They were incomplete, but they definitely indicated that the assumptions often made by engineers as to the effect of rapidly moving loads were not justified. In view of the publication in the early part of this year of the report of the Bridge Stress Committee published by the Department of Scientific and Industrial Research, of which perhaps it is only necessary to say that it is worthy of its distinguished chairman, Sir Alfred Ewing, and his colleagues, it is fitting to refer particularly to this subject of impact on bridges.

So early as 1849, in the Report of the Royal Commission on the use of wrought iron in railway bridges, the subject was discussed, and Sir George Stokes gave a mathematical solution for a load moving over a girder, but this solution was of little value in practice. For eighty years the effect of travelling loads has been treated in an empirical illogical manner and a number of impact formulæ which the Bridge Stress Committee Report shows have no valid foundation, have been used rather blindly by engineers. The report shows very clearly that what is important is not the fact that the load is applied suddenly to the structure, but the possibility of synchronism or otherwise of the structure with the periodicity of unbalanced forces due to the engine or to other causes. Experimental data of the vibrations produced in the structure by the various types of moving loads have been carefully obtained and methods of analyses developed which have made it possible to determine with some degree of precision the true impact factors to be applied.

Thus a problem of real difficulty, in connexion with which doubt and uncertainty has probably led to expenditure far greater than the necessities of the case demand, comes within the possibilities of solution. The carefully conducted work of the

Committee spread over a few years has given more precise guidance for future designers than a hundred years of practice.

Aeroplanes and Airships.

The development of the forms of aeroplanes and rigid airships and the determination of the forces acting upon them—lift and drag—and the distribution of these forces, is another illustration of the splendid use that can be made of the combination of experiment and mathematical analysis. Following the fundamental principles of Newtonian mechanics, dynamical laws of similarity have been developed which, in combination with the wind chambers and the precise measuring devices used for the determination of forces and moments acting upon models, have made it possible to anticipate certain of the forces acting upon machines. Other forces could only be estimated from meteorological data obtained from an examination of the velocity and upward and downward currents of air which a ship or aeroplane may suddenly encounter.

Much could be said of the many other contributions of ' pure science ' to the successful development of the aeroplane. Many of the details and instrumental equipment owe much to science, but success could not have been achieved if these gifts had not been supplemented by the application of the experimental method, in which precise measurement has played an important part, to the solution of the specific engineering problems associated with the engine and the structure.

Materials.

Allied to the subject of structures is that of the strength of materials and their behaviour under various types of stress. For nearly seventy years experiments have been carried out to determine the effect of repeated stresses on metals, but the development of high-speed machinery during the last twenty years has focused attention upon this important subject, and it is now realised how imperfect is our knowledge.

A vast amount of experimental data has been accumulated, and it has been clearly shown that the safe range of stress to which a piece of material can be subjected for, let us say, an indefinite number of times, depends in some way, not yet clearly defined, upon other and more easily determined physical properties. But it is not yet always possible to foretell that some element of a locomotive or of an aeroplane engine, or structure, or other machine will not fail under the conditions it has to meet in practice. Small discontinuities in the structure of wheel tyres, a surface defect in an axle, a wheel gripping very tightly on an axle at one section, surface cracks which cannot even be seen by the microscope on a wire used for a rope, or in the disc of a steam turbine rotor ; the surface condition of a quenched and tempered spring used for a locomotive, an aeroplane engine, or a motor-car, may lead to failure under the repeated stresses due to the normal forces acting upon the element, or due to repeated blows, such as, for example, a locomotive experiences whenever it passes over a rail joint, or a motor-car along a road. Cam-shafts for the stamping mills used in the gold mines frequently fail, and engineers and metallurgists are often at a loss to give a reasonable explanation. The whole problem is bound up, not only with the physical properties which statical experiments are capable of testing, but apparently in some unknown way with the nature of the crystal structure of a metal.

Roads.

Before concluding, I should like to refer to another subject of interest. The rapid developments of road traffic during the last quarter of a century has made the road problem one of considerable importance. From the point of view of the user and the community, the general policy of road construction, the capital expenditure involved, and the cost of upkeep are of primary concern. These are dependent upon the materials available and the use made of them. Incidental to the problem is that of vibrations produced in structures adjoining the road and the probable damage accruing from them, but of this there is only time to say that experiment is necessary to determine the importance of these vibrations on the materials of structures.

Reference has already been made to the lack of knowledge of the effect of blows and stresses due to vibrations in causing failure in metals, and the lack of precise knowledge which will make it possible to choose with assurance the particular material to meet certain circumstances. The problem of road surfaces is in a large measure one not only of the suitability of materials to resist impacts but also of the prevention of impacts.

Many experiments of actual road surfaces are being carried out in all parts of the civilised world, but considering its economic importance, the cost of upkeep of roads and the inconvenience of repeated repairs, it would appear that it would be well worth while, even though there may be doubt as to whether any definite and final conclusions can be reached in the laboratory, to let carefully but boldly conceived laboratory experiments direct the large-scale experiments much more than at present. If the history of other engineering developments is to repeat itself, only by such a procedure is the solution likely to be found.

There is another aspect of the subject which is perhaps related more to economics than to engineering, but it nevertheless demands a definite scientific approach, rather than a policy of drift. I refer to what has almost become a contest between road and railway development. At home there seems no doubt that thousands of tons of heavy materials are carried upon roads, with some element of convenience, it is true, that should be carried on rails, at much greater gross cost to the community than if sent by rail. The calorific value of the fuel consumed per ton mile and consumption of other materials is greater for road than for rail transport, and the actual damage done to road surfaces and vehicles is much greater for the heavy loaded road vehicles than for rail vehicles. True it is that flexibility, direct delivery, and many other

advantages are claimed for road traffic which may far outweigh the disadvantages just referred to, but a failure to visualise the problem of internal transport as a whole may lay unnecessary burdens upon the community. In the opening out of new country that may be the problem in South Africa. I venture to suggest that a courageous but, so far as is humanly possible, a 'scientific' policy of development by road and rail should be followed.

Science in Engineering.

The argument of this address can be summarised into a few sentences. New epoch-making developments in engineering depend upon the discovery of new facts of science and upon materials and technical processes. The only hope of solving many of the problems which face the engineer to-day is by carefully organised experiment. Engineering is of such vital importance to modern life that not only manufacturers but also large users, public authorities, and governments must be interested and provide funds for research.

In Great Britain a good deal of engineering research is being done by large firms, by research associations connected with certain industries, by the universities and by the technical colleges, the National Physical and the Building Research Laboratories, which are under the direction of the Department of Scientific and Industrial Research. This Department also assists research associations by grants, and the universities by the provision of research scholarships and research assistants, but at present it seems that sufficient research is not being done, and that not nearly enough research workers are being trained to meet the needs. How can the demands of the case be met?

It would appear that we must look largely to the universities to train research workers. Training in strict habits of observation and in the investigation of problems theoretically and by experiment should form part of the work of all engineering students. Much of the theoretical knowledge that a young engineer requires to learn is now to be found in excellent text-books and in current periodicals, and these he should be taught to read critically and with understanding, but he should also be taught to face all his problems in the spirit of an investigator. Certain selected students should be encouraged to remain at the universities after graduation or to return after some experience of actual works to engage specifically in research.

Engineering needs such men, some to give their whole time to research while others carry the spirit of research into the ordinary problems of industry and engineering. Employers, public authorities, and governments must utilise this research ability, and more men should find their way into industry from the research institutions. The universities, however, cannot do this most important work of training research workers unless they are adequately equipped and staffed to give members of the staff the necessary time for research and to devote themselves to the training of students in research. To this end sufficient funds must be provided from private and public sources.

The engineer is faced with many unsolved problems. Nevertheless, he must find immediate, if only approximate and tentative, solutions to many of them, and in the solution he often has to deal with many types of men. If experimental science and mathematics cannot give him an exact solution he must still carry on, and in this way much has been achieved. It is for this reason that the engineer has to learn much by actual experience in the workshop, in the field, and frequently he becomes impatient of science and lays too great emphasis upon experience. Manufacturers wish to see returns upon their capital and remuneration for their energy, but as an effective guarantee of future progress and in the solution of many problems in design, in processes, in materials, as well as in the discovery of new methods, it is necessary, as Francis Bacon would to-day remind us, "to apply natural philosophy to particular problems, and particular problems must be carried back to natural philosophy".

News and Views.

On Sept. 14 most hearty congratulations will be extended by a large circle of men of science in Great Britain and elsewhere to Prof. Ivan Petrovitch Pavlov, the distinguished Russian physiologist, on the occasion of his eightieth birthday. He was born—son of the village priest—in the district of Rjäsan, Russia, on Sept. 14, 1849. Pavlov, after graduating at the University of St. Petersburg, engaged in medical studies, showing, very early, marked aptitude for experimental research, combined with adaptability in matters requiring manipulative skill. This natural bent was encouraged by two years' guidance in Germany in the laboratories of Ludwig and Heidenhain. Returning to the Russian capital, Pavlov filled various important academical posts where his scientific activities and his acumen had ample play. Thus began that broad scheme of work, foreknowledge, and intensive application to novel modes of procedure which led ultimately to the opening of new chapters in physiological history. Little effort was required to attract to his laboratories pupils and associates who shared his patient enthusiasm.

Pavlov's earliest researches (dating from 1878) related to the physiology of the circulation, and the dog formed a convenient subject for observation. In these experiments he trained a dog to allow the insertion of a cannula in a small superficial artery on the inner side of the knee-joint and to remain quiet while the blood pressure was noted. Prof. E. H. Starling has recorded the extreme care and solicitude evinced throughout by Pavlov for the animals which were essential for his varied purposes. He would take them home from the laboratory and "in his small flat they would be looked after by his wife, with the

hildren". Long-continued and masterly investigations of the physiology of digestion received recognition in 1904 by the allotment of the Nobel prize for medicine. By the method which he called that of conditioned reflexes', Prof. Pavlov studied from physiological point of view the influence of the higher brain centres upon the secretion of saliva. He was accorded a special welcome in London on Oct. 1, 1906, where he delivered the Huxley Lecture on various aspects of his exacting researches. In the following year Prof. Pavlov was elected a foreign member of the Royal Society, and in 1915 he was awarded the Copley Medal for his investigations in the physiology of digestion and the higher centres of the nervous system. We are glad to be able to publish a review elsewhere in this issue (p. 400) directing attention to Prof. Pavlov's collected addresses, which are now available in English. Readers of NATURE will remember that Prof. Pavlov's portrait appeared in our series of Scientific Worthies on Jan. 3, 1925.

THE Schneider trophy contest has been won for the second time in succession by Great Britain with an advance of mean speed over the performance of two years ago from 450 km./hr. to 530 km./hr. The details of the winning seaplane are still 'secret', and indeed the actual performance of the engine cannot yet be known accurately to the makers. A rough estimate puts the total weight at about 1½ tons with one hour's fuel, surface about 10 m.², span 8 m., power—an estimate so high as 1200 kw. has been published for the normal 600 kw. Rolls-Royce engine with special supercharging device—power plant weight 750 kgm. It will be understood that the figures are only intended to give an idea of the proportions of these racing machines, based on probable developments. The speed expected on a straight course is in the neighbourhood of 570 km./hr. or 160 m./sec.—exceeding half the speed of sound, which may be taken with some confidence as an upper limit. Hitherto the advances in speed have been roughly in equal steps, but in future the rate must fall off as the limit is approached.

THE theory of similar structures has been adduced to prove that, other things being equal, the smaller an aeroplane the better it flies, and the proposal has been made that racing aeroplanes should be built down to the smallest pilots available. The Italians have put this proposal into practice, but the other things were apparently not equal, and the theoretical view still awaits decisive confirmation. An objection has been made that the designer who is willing to risk the highest landing speed gains a decisive advantage over the others. Already the seaworthiness test has become more or less farcical, and the trial is one of pure speed. These points might be met by suitable rules, specifying the size and weight of the pilot, the minimum landing speed, and any other desired figures. But however this may be, the contest is bound to become each year more fantastically difficult and expensive until the trophy is won outright or until it dies out for want of competitors. In the meantime, it undoubtedly adds to the prestige of the winners.

LETTERS from rainfall observers in various parts of England, which have appeared in the daily papers, show that up to the end of August there were still districts where the rainfall of the present year was below 50 per cent of the normal, and that for many places this year's drought is the most severe for such a long period since reliable records began. At the end of June, regions with less than 50 per cent of the normal occurred in Ross and Cromarty, in the English Midlands, and in south-east England. Information from Scotland is scanty, but suggests that the rainfall of July and August has gone some way towards bringing the amount to a more normal proportion in the dry area of the north. Over England it is probable that the driest region is now more in the southern Midlands and the south-east rather than in the northern parts of Nottinghamshire and Derbyshire and southern Yorkshire. At Margate the total for the eight months was only 6·37 inches (48 per cent of the normal), and an observer in Pershore gives reports 7·54 inches compared with a normal of 15·27 inches (49 per cent). At Worksop the percentage is 50, at Skegness 51, at Bedford and Belper 55, and at Bradford 56. Farther south the very small total of 7·45 inches for the first eight months of the year is reported from Basingstoke.

EXCEPT for a week or two in the middle of July, exceptional heat has seldom accompanied the drought, and this has had an important effect in checking excessive evaporation and so moderating the ill effects of the drought on vegetation. From Aug. 31 up to Sept. 9, this has been very far from the case, especially in the south-east of England and the southern Midlands. Examination of the Greenwich records back to 1841 reveals only four occasions when anything comparable with the heat of the early days of this month has occurred in September, and all of these have, curiously enough, been within the last 35 years. In 1895 the maximum temperature exceeded 80° on six successive days, from Sept. 23 to Sept. 28. In both 1898 and 1906, 90° was attained three times, and in 1911 twice. The mean maximum for the first nine days of the present month—81·5°—was very slightly exceeded in 1911, but the nights then were not nearly so warm. The absolute extreme for the 89 years was 94°, on Sept. 8, 1911. Taking into account night as well as day temperatures, and the duration of this abnormal warmth, there can be little doubt that it will constitute a 'record' for autumnal heat for a considerable part of England, and considered in conjunction with the drought and the intense cold of February, will make 1929 one of the most interesting years meteorologically of which we have any record.

THE U.S. Bureau of Mines has just issued among its annual reports that upon coal in 1927. In addition to the usual statistical tables and graphs, there is an interesting review of the coal industry in the United States. It is shown that the output of bituminous coal in 1927 was exceptionally low, showing a decline of nearly 10 per cent below that of 1926. A part of this decline appears to have been due to lower home consumption as well as to a large falling off in the export trade, the report stating

that "from 21,510,000 net tons in 1926, when the overseas trade was greatly stimulated by the world-wide demand for coal caused by the British strike, sea-borne exports of bituminous coal fell to 3,288,000 tons in 1927". It is interesting to note that the falling off in the demand for bituminous coal appears to be due to a number of causes, one of them being the rapid growth of alternative sources of power, namely, oil, natural gas, and water power; another reason is the decided advance in fuel efficiency which is well marked in the case of railroad fuel, which absorbs about 24 per cent of the supply of bituminous coal; in the iron and steel industry, which absorbs about 16 per cent, and even more markedly in the consumption of coal by the electric utilities; in 1922 the average consumption per kilowatt-hour was about 6·6 lb. of coal, whereas in 1927 the average fell to 1·84 lb. On the other hand, there appears to be a small increase in the consumption of bituminous coal for domestic purposes, that is, for the heating of houses and other buildings.

THE Support of Workings in Mines Committee of the Safety in Mines Research Board has recently issued its fifth report (Safety in Mines Research Board, *Paper* No. 55. London: H.M. Stationery Office, 1929. 2*d.* net), dealing with the coalfields of Lancashire, Cheshire, and North Wales upon exactly similar lines to those adopted in the previous reports upon other British areas. The general impression given by this report is that the districts under investigation are not so well advanced in mining matters as some of the others already investigated; we find, for example, in the report such statements as these: "The accident rates from falls of ground in Lancashire and Cheshire and in North Wales are above the average for the whole country." "Very little machine mining is carried on." "In Lancashire and Cheshire the number of longwall machines in use is comparatively small." The same reflection emerges from the somewhat numerous recommendations put forward in the summary of the report, some of these being of the type that should, one would have thought, have naturally suggested themselves to those in charge of the mining operations.

IT is interesting to note that this report lays considerable stress upon the advantage to be obtained by the use of steel props, steel bars, and steel arches, which apparently have replaced wood only to a very small extent in the coalfields of Lancashire, Cheshire, and North Wales in spite of the great measure of success that has attended their employment in other districts. It is interesting to note that a very large variety of methods of working is employed under even apparently somewhat similar conditions, but unfortunately the report does not indicate which method or methods should receive the preference. It must not be forgotten that these coalfields present a number of difficulties in working; they are very much cut up by faults, some of which have an exceptionally large throw, and, further, the fields contain a large number of seams, some of which are occasionally leased to different collieries even in the same area, thus producing difficulties in working, which a more systematic method of attack could undoubtedly have avoided. Like the previous reports, this one contains a large amount of valuable information and hints which cannot but be of considerable advantage to those engaged in operating the coalfields under investigation.

As president of the sixteenth Indian Science Congress, held at Madras in January last, Prof. J. N. Mukherjee, of the University of Calcutta, presented a very interesting address entitled "The Physical and Chemical Points of View in the Theoretical Treatment of Colloids". Prof. Mukherjee is well known as the chief exponent of colloid chemistry in India, and the work which he has carried out, either alone or with numerous collaborators, has established his reputation throughout the scientific world as an eminent worker in this field. His address to the Indian Science Congress deals with some very difficult questions. It may be divided into three parts. In the first part the author discusses the colloidal particle as a molecule in the physical and in the chemical sense; whilst in the second part he deals with the thermodynamic treatment of colloidal systems. These very interesting sections of his address treat the much-debated question as to how far a colloid particle may be regarded as a thermodynamic component of a one-phase system, and as to how far this concept breaks down in many cases. The considerations which he advances will do much to remove misunderstanding in this part of the subject.

IN the latter part of his address, Prof. Mukherjee contrasts the surface association theory and the theory of ion adsorption, and points out that the former theory, which is of a more chemical character, leads to many difficulties and must in general be replaced by the theory of ionic adsorption. A good deal of Prof. Mukherjee's own work has dealt with this subject, so that he is able to discuss it from intimate acquaintance. The whole address is an excellent example of the great progress which India has made in science during the last twenty years or so, and, in spite of the modesty of the author, would have been listened to with attention and interest in any body of scientific men throughout the world. Prof. Mukherjee has now established an active centre of colloid research in the University of Calcutta, as is evidenced by the numerous papers which he and his collaborators have published in recent years.

IN the account by Dr. Montandon of the new 'anthropoid' discovered by Dr. de Loys in South America which is to appear in the next issue of the *Journal de la Societe des Americanistes de Paris*, and of which advance copies are now available, attention is directed in a supplementary note to two pieces of documentary evidence which may have a bearing upon the question of the occurrence of apes or monkeys of unusual size in America. Of these, one is a reference to certain statues in Yucatan which are said to resemble the gorilla. They are exhibited in the Archæological and Historical Museum of Merida (Yucatan) and are said to have been discovered at Tekax. One of them appears to be bisexual, a feature which recalls the peculiarities of the sexual organs of

e female which was shot by Dr. de Loys. The neral configuration of the statues is that of anthro- ids of powerful physique. The second document a reference in the "Cronica del Peru" of Pedro de eon, dating from the middle of the sixteenth century, certain very large apes of whom the Indians made xual use, from which unions were said to have re- lted monsters with the heads and sexual organs of en and the hands and feet of apes. They were of ll stature and hairy, and had no language, but gave ice to a plaintive cry. These references are of great terest in view of Dr. de Loys' discovery, though it certainly remarkable that if monkeys or apes of is size and character were known to the Maya, ey should have remained unrecorded by European servers until now.

The editor of *Antiquity* has been a consistent advo- te of the use of the aeroplane as an adjunct in rchæological exploration. The numerous records of scovery which have appeared in the pages of that eriodical more than justify his views. Perhaps the ost important of these has been the detection of Woodhenge, the Wiltshire prehistoric monument in ne form of a circle in which wooden posts were used stead of the, to us, more familiar stone. The litorial notes in the September issue of *Antiquity* cord the discovery, again by aeroplane, of another Woodhenge, this time outside Norwich. It was de- cted by Wing-Commander Insall, on June 18 last. he site is in a grass field called Bridge Meadow, in ne northern corner of the Parish of Arminghall, pposite Old Lakenham. It shows up well in the r photograph as two dark concentric rings with ine dark holes within the inner ring, representing ithout doubt the wooden post holes. The outer ng is 10 ft. wide, the inner 25 ft. wide with a gap or auseway 14 ft. wide. The editor, when flying over the te, made a further important discovery in the shape f two concentric rings half a mile to the south, which ndoubtedly represent a disc barrow, the inner ring rrounding a small central burial ground. This, is suggested, is probably contemporary with the Woodhenge circle, as a similar but even closer associa- on occurs at Woodhenge in Wiltshire. In discussing ne bearing of the discovery, the editor suggests that ne evidence, pointing to the association of the Woodhenge type of monument with the Beaker olk, would lead one to seek further traces of this eople of Rhenish origin in East Anglia owing to its eographical position.

The Indus and tributary streams from the Hima- yas flood annually, but this year, as the result of normally heavy rains in the Punjab, Baluchistan, nd Kashmir, the flooding is exceptionally heavy and causing much devastation. The *Times* reports hat near the end of August the waters of the Indus Attock, with a height of above 66 feet, stood igher than at any period during the last half-century. his was a higher level than during the flood which ecently resulted from the bursting of the Shyok acier dam. The Jhelum and the Chenab are also serious flood. Many towns are in peril and several ilway lines are breached. Many villages have been overwhelmed. The peak of the flood was reported on Sept. 8 to have passed the Sukkur barrage, but the barrage structure is reported to be safe. Last week it was anticipated that a further rise of six inches in the level of the river would necessitate the evacuation of all the low-lying parts of the lower Indus valley. The one hope is that the river bed has been scoured deeper by the rush of the floods and so can carry more water than formerly. Strenuous efforts are being made to heighten and strengthen the bunds before the peak of the flood arrives.

The opening of the great Alfred Beit bridge across the Limpopo River near Messina on Aug. 31 marked an important step in the development of communications in South Africa. The bridge, which is to take both rail and road traffic, is 1500 ft. in length and consists of fourteen spans. It will eventually allow the railway from Cape Town, Bloemfontein, and Pretoria to be continued to West Nicholson, and so connected with the railway to Bulawayo, Victoria Falls, and Katanga. This will provide an alternative route between Rhodesia and Cape Town and Durban, and will make Delagoa Bay a rival to Beira for Rhodesian sea-borne traffic. The line from the Limpopo bridge to Delagoa Bay is already in existence. The present railway routes to Rhodesia are either from Beira or from southern ports via Mafeking to the west of the Transvaal. The mileage between Durban and Bulawayo will be considerably shortened on the completion of the new line.

The increasing need of reaching biological conclusions regarding the slaughter of whales is emphasised in the second Annual Report of the *Discovery* Investigations (London: H.M. Stationery Office, 1929. 1*s*. net) which covers a period of seventeen months. The Antarctic whaling season of 1927–28 broke all records. Off the South Shetlands, 5500 whales were taken and the yield of oil (47 per cent more than that of the previous season, which itself was all but a record) was more than 66,000 tons; while together the Falkland Island Dependencies exported 134,000 tons of oil, of a value of £28-£30 a ton. The question is whether this enormous slaughter can be sustained without undermining the stock. The *Discovery's* results sound a grave note of warning. A very large proportion of the whales examined from the general catch were immature—in 1925–26, 58 per cent of blue whales and 26 per cent of fin whales. Though these may not have been fair samples of the whole stock, it is clear the proportion suggests a wanton and wasteful slaying. This is the more to be deplored since the evidence collected by the investigators shows that the whale stock is slow-breeding and therefore slow in recuperation. The period of gestation appears to be about a year, and young to be born once in two years at most.

The proceedings of the Third Pan-Pacific Science Congress, which was held at Tokyo in October and November 1926, have recently been published by the National Research Council of Japan. They occupy two volumes containing nearly 3000 pages, practically all in English, the exceptions being in French and

German. More than 2500 pages are devoted to technical communications on astronomy, meteorology, oceanography, seismology, terrestrial magnetism, geology, geography, botany, zoology, anthropology, architecture, agriculture, and medicine, with a direct bearing on the Pacific region, its neighbouring lands and their inhabitants. Many of these communications are of high scientific merit, and the *Proceedings* as a whole represent a contribution to knowledge of the greatest value. Apart from their use as an encyclopædia on the Pacific, showing the present state of knowledge on the subjects treated and also various large-scale plans for the increasing of such knowledge, these volumes are very well worthy of study as showing what is possible in a great international congress. Most of the communications were made before large and appreciative audiences, and provoked discussions of the best type. The National Research Council of Japan is to be congratulated both on the volumes themselves and on the organisation of the Congress which was the reason for their appearance.

THE Colombo Museum, foreshadowed in Sir William Gregory's speech to the Legislative Council of Ceylon in 1873, was opened to the public in 1877. Accordingly, Dr. J. Pearson's Administrative Report for 1927, which has recently been received, takes occasion of the fiftieth anniversary of the opening to review the development of the Museum and its collections. The Museum owes its origin to the efforts of the Ceylon branch of the Royal Asiatic Society, and from the beginning its purpose has been strictly limited and defined—the storing and exhibiting of the productions of Ceylon. Even this limited field has required more space than was originally contemplated, and the original building, erected at a cost of Rs.120,500, was extended in 1907 and is now in course of further extension. The Director's suggestion that stone monuments, which need protection from sun and rain only, might be housed in an open roofed gallery, seems an excellent one. It is clear, however, that this side of the Museum's activities merits more attention than has been paid to it, and that the Museum staff requires strengthening by the addition of professional and technical workers familiar with the art and archæology of Ceylon, and with the preservation and preparation of art objects for exhibition. The use made of the library shows a gratifying increase.

IN "Zoologische Stationen" and "Fischerei-biologische Stationen", which form Lieferung 13, Teil 1, f_1 and f_2 of "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928), Dr. H. C. Redeke describes the marine zoological stations and fisheries institutes situated on the coasts of the North Sea and Baltic. The oldest North Sea station is that of the Niederländische Tierkundliche Gesellschaft, founded in 1872, since 1889 the permanent station of Helder, Holland. The largest, the Biologische Anstalt in Heligoland, was founded in 1892. There are altogether a dozen zoological stations distributed throughout the area described, in England, Scotland, Holland, Germany, Norway, Denmark, Sweden, Latvia, and Finland, besides the government fisheries stations in Belgium, Denmark, Germany, England, Scotland, Finland, Holland, Norway, Sweden, Russia, and Poland. Notes are given on all these, with the names of directors and staffs, amount of accommodation for workers and available boats for research, together with the organ (if any) in which the work of each one is published. A list of papers giving descriptions of most of the laboratories is also included. The whole forms a most useful work of reference.

THE seventy-fourth Annual International Exhibition of the Royal Photographic Society will be held at the Society's house at 35 Russell Square, London, W.C.1, on Sept. 14–Oct. 12.

THE sixth annual conference of the Association of Special Libraries and Information Bureaux will be held at Trinity College, Cambridge, on Sept. 20–22. The president-elect, Sir J. J. Thomson, will deliver an address on the first evening of the meeting, and afterwards Brigadier-General Magnus Mowat will review the past year's work of the Association, and Mr. Laurie Magnus will deal with the approach of the producer to the consumer of information. At the sectional meetings, such subjects as technical English, books versus text-books in schools, training of special librarians, and the international organisation of information services, will be discussed.

UNDER the Order in Council dated Feb. 6, 1928, the Lord President of the Council has appointed the Right Hon. Lord Rayleigh, Sir Arthur Balfour, Sir William Bragg, and Sir James Walker to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The following members of the Advisory Council have retired on completion of their terms of office:—Sir Harold Carpenter, Dr. G. C. Clayton, Sir Richard Glazebrook, and Sir James Jeans.

AN International Congress of Archæology will be held at Barcelona on Sept. 23–29. The date coincides with the International Exhibition, in which an important place is being given to Spanish art and archæology. Excursions will form part of the programme to enable visitors to view the principal centres of archæological interest in the neighbourhood. Particulars of the Congress may be obtained from the secretary, Prof. Bosch-Gimpera, University, Barcelona.

A COMMITTEE has been appointed, consisting of Lord Weir of Eastwood (chairman), Sir Ralph Wedgwood, and Sir William McLintock, with the following terms of reference: "In view of the progress which is being made towards widespread availability of high tension electrical energy, to examine into the economic and other aspects of the electrification of the railway systems in Great Britain with particular reference to main line working". The secretary to the committee will be Colonel A. H. C. Trench, Ministry of Transport, 6 Whitehall Gardens, S.W.1.

ANOTHER interesting catalogue of Messrs. F. dwards, Ltd., 83 High Street, Marylebone, W.1, has ıst been issued, namely, No. 517, entitled "Man ırough the Ages: his Origin, Customs, and Beliefs", ₹ing a list of upwards of 1300 second-hand works ₹lating to anthropology and allied subjects.

IN the new edition in preparation of "Clegg's ıternational Directory of the Book Trade" the ₹ction devoted to book collectors is being developed ıd the collectors are being classified according to the ıbjects in which they are interested. Anyone wish- ıg to have his name included should communicate ith "Clegg's International Directory of the Book rade", Lodgewood, Gravesend, Kent, giving name, ddress, and subject of interest.

APPLICATIONS are invited for the following appoint- ıents, on or before the dates mentioned:—An ssistant lecturer and demonstrator in the Depart- ıent of Zoology of the East London College—The Regis- ₹ar, East London College, Mile End Road, E.1 (Sept. 4). A visiting teacher of mathematics at the Chelsea olytechnic—The Principal, Chelsea Polytechnic, Ianresa Road, S.W.3 (Sept. 16). A master of archi- ₹cture at the King Edward VII. School of Art, rmstrong College—The Registrar, Armstrong ollege, Newcastle-upon-Tyne (Sept. 18). Teachers f practical decorative painting and leaded glass ork, design and construction of scroll and beaten ₹ad work, design and the manufacture of ceramics nd pottery, at the School of Applied Art, Cairo—The nder-Secretary of State, Ministry of Education, Cairo, gypt (Sept. 20). A vice-principal of the County Train- ing College, Crewe—The Secretary, Education Office, Municipal Buildings, Crewe (Sept. 27). An engineering inspector under the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Sept. 28). A lecturer in engineering at the Witwatersrand Technical Institute—Chalmers and Guthrie (Merchants), Ltd., 9 Idol Lane, E.C.3 (Sept. 30). A head of the Engineering Department of the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (Sept. 30). A vice-principal of the Training Department of Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14 (Oct. 3). A librarian and guide-lecturer at the Horniman Museum, Forest Hill—The Clerk of the London County Council, County Hall (Room 202), Westminster Bridge, S.E.1 (Oct. 8). A Stokes studentship at Pembroke College, Cambridge—The Master of Pembroke College, Cambridge (Oct. 10). A Secretary of the Museums Association—D. W. Herdman, Art Gallery and Museum, Cheltenham (Oct. 21). A trained bacteriologist for research upon cholera problems in the laboratory and field under the Indian Research Fund Association, also a research worker for work on malaria in the field and in the laboratory under the Malaria Survey of India—The Secretary, Indian Research Fund Association, Simla, India. A part-time demonstrator in chemistry at the University College of the South-West of England, Exeter—The Registrar, University College of the South-West of England, Exeter. A technical assistant in the Radium Department of St. Bartholomew's Hospital—Prof. F. L. Hopwood, St. Bartholomew's Hospital, E.C.1.

Our Astronomical Column.

A Flashing Meteor.—Mr. W. F. Denning writes: I observed a flashing meteor on Saturday, Aug. 31, ₹ 9h 7m P.M. Its motion was very swift and it gave a ery brilliant flash at its disappearance, where it left short, nearly vertical streak, about 2° long. The ash lit up the sky and country, but was of very ransient duration and resembled lightning more than meteoric outburst. The streak remained in view r six or seven seconds, and its position was from out 227° + 8° to 226° + 6°. Duration of the flash ust have been a small fraction of a second, but the me interval was so brief that I could not estimate it ₹actly.

"I observed a well-defined shower of 12 Draconids ı the same, and following, night from 292° + 61°, and ıe fireball's flight was directed from about this point. attribute the object to this centre, though its aspect as not conformable with that of a normal Draconid. ortunately, several others witnessed the flight of the eteor and roughly noticed its position and direction. was seen from Truro and Camelford, and a rough ojection makes the height of the object from about to 57 miles, above points in the sea between the est extremity of Cornwall and 30 miles west of embrokeshire. Its velocity was probably much ore than 50 miles per second. Occasionally other ell-observed velocities have shown considerable scordances with those computed on the basis of arabolic or elliptical speed."

Silvering the 100-inch Mirror at Mount Wilson.—n interesting article by Mr. Russell W. Porter in the *cientific American* for September describes the pro- cess of resilvering the great mirror of the 100-inch telescope at Mount Wilson, which is carried out every six months. The telescope is anchored in a vertical position, and the mirror lowered on a lift through a manhole in the floor. The old film is removed by acid; water jets are then turned on, and the mirror cleaned with cotton swabs. The reducing solution is poured on, and the silver solution added in two stages. It is left on for half an hour, being stirred meanwhile; the spent solution is drained off; the surface is washed and dried, and then polished, first with a cotton pad, afterwards with chamois and rouge. About a dozen men are occupied in the task, of which a coloured illustration is given. The final film is 1/100,000 of an inch thick, and contains only one per cent of the silver of the three pounds of nitrate of silver in the solution.

The Cowell Method of Computing Perturbations.—The method of mechanical quadratures introduced by Dr. P. H. Cowell for studying the perturbations of the eighth satellite of Jupiter and Halley's comet has been found convenient by many other computers. Dr. Innes, N. Komendantow, and Numerow have used it largely, but the two latter apply it in a modified form. Dr. G. Stracke contributes a table of the function ω^2k^2/r^3 to *Astr. Nach.* No. 5647; ω is the interval in days, k the Gaussian constant, r the distance from the sun. The values of ω in the table are 2^d, 4^d, 8^d, and the intervals of r are 0·01 from 1·50 to 6·00, and 0·1 from 6·0 to 35·0. The table serves for nearly all the minor planets and for many of the periodic comets.

Research Items.

Cranial Capacity of Filipinos.—Dr. Juan C. Nañagas of the College of Medicine, University of the Philippines, Manila, has made a study of the cranial capacity of a collection of some six hundred crania in the Department of Anatomy in his University. Of these there are a fair number of known cases of Filipinos; upon these is based a report published in the *Philippine Journal of Science* for January last. Of the four hundred and fifty-eight skulls examined, four hundred and thirty-six are males. The maximum cranial capacity for the male group is 1655 c.c., and the minimum, 1083 c.c. For the female group, based it is to be noted on only twenty-two specimens, the maximum is 1480 c.c. and the minimum 987 c.c. The main cranial capacities are for the male group 1301 c.c., with a standard deviation of 10·858; for the female group 1192 c.c., with a standard deviation of 11·8. A comparison with other races, white, Ainu, and negroes, both African and American, shows that in the Filipino cranial capacity is relatively smaller, falling more or less in direct proportion to the difference in stature and general physique existing among the various races.

Archæology in the Taos Valley, New Mexico—In 1920 a survey of archæological sites in the Taos Valley, New Mexico, was made by Mr. J. A. Jeançon, of which the results have been published in the *Smithsonian Miscellaneous Collections*, vol. 81, No. 12. The existence of prehistoric ruins here had been known for some time, but they had not been considered sufficiently important for excavation. As it turned out, this view was erroneous. Two mounds were excavated at Elano and their ruins of adobe buildings uncovered. The smaller was a seven-roomed house which showed evidence of long occupation. The second mound showed two levels of occupation, and a building belonging to the second was excavated. It had been an eighteen-room dwelling-house with a kiva. It had been destroyed by fire. No evidence was obtainable as to the method of roof construction except that the secular rooms had a central ceiling support, and the kiva covering had rested on four upright posts. The kiva had been placed in the centre of a compact mass of rooms instead of on an open plaza detached from the main building. The pottery gave evidence of a relationship to that of the south-western Colorado and the Rio Grande wares of the late black on white period. No special features occurred in the stone or horn objects found, the chief points to be noticed being the absence of grooved axes and the use of large pieces of micaceous schist for cooking slabs. It would appear that the culture of the sites represents a late phase of the black on white period just preceding the beginning of the glazed wares in the Rio Grande.

Animal Habits and their Association with Disease.—Apart from their public interest, the larger zoological gardens provide an important source of scientific research, particularly as regards the incidence of disease in the lower animals. In this respect the London Zoo stands in the forefront in its publication of reliable data, but even here no summing up of results has been attempted such as Herbert Fox gives in an unusual study contributed to *Proc. American Phil. Soc.*, vol. 68, No. 1. He examined, with the view of discovering the particular organ the breakdown of which caused the death of the creature, 2571 representatives of 37 families belonging to 5 orders, and varying in number from 2 giraffes to 429 old world monkeys. We mention one result as a sample of the conclusions reached. In the contrast between the causes of mortality in carnivores and herbivores, it is found that amongst the former, with their strong jaws, rapid deglutition, strong muscular intestines, and short digestive tract, there is outstanding susceptibility of the intestinal tract. Curiously enough, the least carnivorous of the lot, the bears, had the highest incidence in this respect. Otherwise, the carnivores show a greater tendency to ductless gland disorders and tumours. The herbivores, on the other hand, lead in diseases of the skeleton and in tuberculosis. These results are derived from captive animals, confined as regards activity and subject to unnatural feeding, so that they may not reveal quite the state of affairs in wild Nature; but until the field naturalist collects more data, they are the best that can be obtained.

Indian Oligochæta.—K. S. P. Aiyer (*Records Indian Mus.*, **31**, part 1, 1929), in an account of the Oligochæta of Travancore, records the finding of specimens of *Aeolosoma travancorense* in which there was not a compact testis; spermatogonia were found on the wall of the dorsal blood-vessel especially in the intestinal region. An ovary was not noticed in any of the numerous specimens examined, but in fully mature individuals a single large ovum was present, attached to the anterior end of which was a cell smaller in size and free from yolk granules. The author suggests that two oocytes are produced, the hinder one developing into the ovum and the anterior one remaining as a nurse cell. There are no spermathecæ, sperm ducts, or oviducts. The other aquatic Oligochæta are Naididæ, represented by eight genera and eighteen species, Tubificidæ, one species, and Enchytræidæ, one species. There are forty-nine terrestrial species recorded, chiefly Megascolecidæ. The most striking structural peculiarity is the presence in a *Megascolex* of a retractile proboscis about 4 mm. in length which arises from an invagination in the dorsal wall of the buccal cavity. It is supplied with a nerve from the same trunk as the prostomium, and the author states that it functions as a feeler. The vas deferens of *Moniligaster deshayesi* is surrounded by numerous leaf-like bodies, each of which is a mass of tubules, and opens into the vas deferens by a short duct. This is unique in the Oligochæta.

Caterpillars and Ants.—The association of ants with the larvæ of 'blue' butterflies has long been recognised, but an addition to our knowledge of the relationship in England has been made by Prof. J. W. Heslop Harrison and William Carter (*Vasculum* for August). Having earlier observed that the larvæ of the Brown Argus attracted ants, and that the seventh and eighth abdominal segments of the larvæ bore elaborate structures, which are believed to emit something in the nature of a scent attractive to ants, they have now solved the question of the identity of the ants themselves. A few of the rare larvæ were found on the leaves of the rock rose; in each case ants were present, and two species were represented—*Lasius niger* and *L. flavus*. The discovery explains the restricted distribution of the butterfly, which appears to be confined to certain hollows carrying an abundance of the thyme-clad hillocks of *Lasius flavus*. The association recalls and foreshadows the more intimate symbiosis in the case of the large blue, *Lycæna arion*, where the larvæ in their last stages live in the nests of, and depend entirely upon the ant *Lasius flavus*.

Floridan Tree Snails.—Those handsome, gaily coloured tree snails belonging to the genus *Liguus* being threatened with extinction, owing to the destruction with the advance of civilisation of the forest

patches they frequent, Mr. C. T. Simpson has been happily inspired, after thirty years' study, to place on record his observations concerning them (*Proc. U.S. Nat. Mus.*, vol. 73, art. 20). The genus, which according to the author includes about a dozen species and a great number of varieties, is found in the northern parts of South America, Cuba, Haiti, Cozumel, and the more tropical part of Florida. The colonisation of Florida took place since early Pleistocene times and originated from Cuba, where the genus was early established, possibly in Miocene times. How this migration was brought about by flotation during gales and the physical changes that afterwards assisted in the spread of the colonists is explained at some length if not altogether convincingly, since no fossil or subfossil occurrences are recorded. Full systematic descriptions of the thirty-five species, subspecies, and colour varieties existing in Florida are given, founded solely on shell characters, and illustrated with forty-six figures on four beautifully executed coloured plates.

Reproduction and Sex in *Ectocarpus*.—A further valuable study of the alternation of generations and of sexuality in *Ectocarpus siliculosus* has come from Miss Margery Knight (*Trans. Roy. Soc. Edin.*, **56**, No. 15, pp. 307-322), who has discovered a striking difference in the life history of this species in British waters and at Naples. In Britain the plant is normally diploid, giving rise to diploid and asexual zoids from plurilocular sporangia. Alternatively, meiosis in the mother cell of the unilocular sporangia is followed by the production of zoids which behave as gametes and, on fusion, re-establish the diploid soma. In Neapolitan examples of the same species, the zoids from plurilocular sporangia are undoubtedly gametal in nature, and both the mature plant and the plurilocular sporangia have *haploid* cells. The absence of unilocular sporangia in the Neapolitan material is interpreted as an indication of the haploid nature of the normal soma. The author's work on the sexuality of the zoids in general confirms that of Hartmann, who found that fusions only took place when the gametes (from different plants) were of sufficiently high and opposite sexual potential. There is also evidence, however, that the numbers of zoid fusions decreased very rapidly after the plants were exposed to light, owing to some effect of the changing environment upon the zoids. Sexual potential might thus be regarded as a function of the previous experience and immediate environment of the individual gamete rather than as a fundamental and constant quality of the parent plant. Further, in some cases, male and female zoids appeared to be produced from a single plant simultaneously. The male zoids could be distinguished from the female by their higher fucosan content, and it appears that the proportion of male to female zoids from a single plant may decrease rapidly during the course of an hour or two. The sex difference is thus associated with metabolic activities and it is, accordingly, not impossible that the previous physiological history of the parent plant might determine whether the plant produced wholly male or wholly female zoids.

Population Studies.—At the July meeting of the Royal Society of South Australia, Dr. Charles Fenner, the acting president, read a paper entitled "A Geographical Enquiry into the Growth, Distribution, and Movement of Population in South Australia, 1836–1927". Though much valuable work along those lines has been done elsewhere, this is the first exhaustive inquiry of its type that has been conducted in Australia. The paper dealt with the whole period of South Australia from its foundation; the initiation and development of the chief influencing factors, such as topography, soil, climate, water supply, railways, harbours, roads, education, research, and invention, were shown in a series of ingenious maps and graphs, and were duly correlated. The population growth and movement were set out graphically on a series of 'spot-maps' (one dot per hundred persons),—one map for each decennial period. The closing portion dealt with what Dr. Fenner calls the 'prosperity graph' of South Australia, which shows in one curve the whole history of the State, with annotations indicating the chief factors and incidents in its development, from the geographical point of view. This graph, which is based on the power of the State to absorb or to repel population from outside, shows a high degree of correlation with other factors that might be regarded as measures of State prosperity or adversity.

Manganese in South Africa.—The recent discovery of important manganese deposits along some thirty-eight miles of the Gamagara ridge near Postmasburg, in the Cape Province, has led to a detailed survey of the ore bodies and the surrounding geological formations ("The Geology of the Postmasburg Manganese Deposits", by L. T. Nel, Geological Survey of South Africa). The deposits occur in two belts running north and south, the western belt being associated with the basal members of the Gamagara Series, whereas the eastern belt is in the Blinkklip breccia or underlying chert breccia. In each the Campbell Rand Series of limestones, dolomites, and cherts is found underlying the ore belt, and while it is not yet clear where the manganese came from, the evidence is strongly in favour of its having been leached from these limestones and reprecipitated as oxide by metasomatic replacement in the situations where it now occurs. There are two principal varieties of ore: one massive and agreeing in composition and properties with *psilomelane*, the other crystalline and corresponding most nearly to *braunite*. The two varieties are intimately associated and they occur in conjunction with manganiferous iron ores. The available tonnage of ore with 40-50 per cent of manganese is enormous, and there are large reserves of higher-grade ore carrying more than 50 per cent manganese. Among the other minerals found in the ore bodies are claret or rose-coloured *manganese-diaspore* and a delicate rose-coloured *soda-rich mica*, representing probably a new species of the mica group.

Simple Soil-Testing Outfit.—The chief aim of the golf greenkeeper is to maintain soil conditions which will encourage fine grasses and at the same time prevent or appreciably reduce the occurrence of clovers, weeds, coarse grass, and earth-worms. It is now well known that this type of herbage is obtained if the soil is acid in reaction, a condition which can be brought about by repeated light dressings of sulphate of ammonia. It is therefore important that greenkeepers should be able to test their soil from time to time by some simple method, so that they may be guided in their treatment. To meet this need the British Drug Houses, Ltd., London, N.1, have produced a 'Golf Links Outfit', in which all accessories for the determination of soil reaction (with the exception of distilled water), are included in a compact leather-board pocket case, price £2 5*s*. A preliminary test is made with B. D. H. Soil Indicator, and the exact *p*H value is then determined by means of the B. D. H. Capillator. Full instructions for the use of the outfit are supplied and a price list of spare items is appended.

Radium *D*.—The issue of the *Zeitschrift für Physik* for June 27 contains two papers from Prof. Meitner's

laboratory, by J. Petrová, in which he describes a modified form of the Wilson cloud apparatus and its application to the study of the β-rays from radium D. The apparatus has been designed so that it can be used with the expansion chamber containing gas at a pressure only slightly in excess of that of the water vapour, and is thus specially well suited for the investigation of particles of short range. The two groups of β-particles which correspond to the two strong lines in the magnetic spectrum of radium D at 30 kilovolts and 43 kilovolts have been resolved in a statistical analysis of the lengths of the trails, and there are also present a number of faster particles, as well as some slow β-particles which are probably the nuclear rays from this element. The papers are illustrated by some good stereoscopic photographs of β-trails, and one of some α-trails in air at low pressure from which numerous long δ-rays are projecting.

Origin of Magnetism of Sun and Earth.—The issue of the *Physical Review* for July 15 is the second for the month, and henceforth it will appear twice a month. The two issues cover the first 386 pages of Volume 34. The later one contains a new theory to account for the magnetic fields of the sun and of the earth by Mr. R. Gunn, of the Naval Research Laboratory, Washington. According to this theory, an electron in motion in the $X\,Y$ plane in a non-homogeneous magnetic field in the Z direction drifts in the X direction by an amount which depends on the rate of change of the magnetic field in the Y direction, which is taken along the gravitational field. This field produces a drift in the $-X$ direction, and if there is an electrostatic field it may produce a drift in either direction along the X-axis. It is shown that the first of these drifts is the greatest and that the electric current due to it is of the right order for both sun and earth. This current is in the direction to increase the magnetic field, but this increase is kept in check by radial electric fields due to temperature gradients and differences of ionic concentration.

Chemical Biogenesis.—Prof. John Read (*Chemistry and Industry*, vol. 48, No. 32, p. 786, Aug. 9, 1929) points out that close structural relationships are often observed to exist between the individual components of a particular essential oil, and that striking parallels may be discerned in many instances between groups of substances occurring in two or more oils from related species. These facts lead to the idea of the derivation in the plant of related substances from common chemical ancestors, as was remarked by Kremers in 1922. Prof. Read suggests that geraniol (or, possibly, its geometrical isomer, nerol) possesses strong claims to be regarded as the immediate precursor of piperitol, piperitone, Δ^4-carene, and other substances which occur in this association in essential oils. All these substances may be depicted as obtained from the parent compound by simple processes of isomerisation, hydration, dehydration, oxidation, and reduction, while geraniol itself may originate from such simple units as *iso*-valeraldehyde. The implied aptitude of geraniol to act in Nature as a precursor of so many other substances may be attributed to the unusual conformation of its molecule, which possesses a structure $-CMe:CH.CH_2OH$ (consisting of a primary alcohol group activated by an $\alpha\beta$-ethylenic linkage) situated in spatial proximity to a second active grouping $-CH:CMe_2$. Migration of a hydrogen atom, in the 'nascent' molecule of geraniol, from the primary alcohol group to one side of the double bond of the second grouping leads to piperitol, piperitone, and α-phellandrene; migration of the same hydrogen atom to the other side of the double bond leads to Δ^4-carene. Prof. Read hopes to submit his interesting ideas to experimental investigation; the problem is certainly an important one, and its solution would throw welcome light upon biogenetical relationships.

Flame Speeds.—Messrs. W. Payman and R. V. Wheeler have had reprinted as a memoir the articles by them on "Flame Speeds and their Calculation" published this year in *Fuel in Science and Practice*. In this they summarise the results of many previous papers, and answer some of the criticisms advanced against the general applicability of the 'law of flame-speeds'. Assuming Le Chatelier's initial phase of slow uniform movement, which we think the authors have established, we may note the curious and significant result—that, when oxygen is diluted with nitrogen to different strengths, the *limit* mixtures of all such atmospheres with a combustible gas, such as methane, propagate this slow flame at a nearly constant velocity—about 20 cm. per sec. The authors find experimentally that all such limit mixtures (of the same kind), made by paraffin-gases with air or oxygen, when mixed together, also form a limit mixture in which flame travels with the same velocity. Again, the authors find that, as a general rule, mixtures of different gases in air or oxygen which have the same flame-speed may be mixed together to give a mixture having the same flame-speed; from this they argue that the two reactions take place independently of one another. It is pointed out that this conclusion is only valid when the combustible gases do not interact in the flame, and where none of the combustible gases decomposes with evolution of heat. Hydrogen mixtures, towards either limit, show variations from the normal owing to the mobility of the H_2 molecule, and carbon monoxide requires the presence of hydrogen or steam to exhibit its due effect. Nevertheless, the authors show that the generalisation is applicable in the case of most industrial gases, and can be usefully employed, for example, in the regulation of gas-fired retorts.

Testing Wire Ropes.—A method of testing for mechanical flaws in wire ropes without subjecting them to actual mechanical tension is a problem which has been studied for many years, especially by colliery engineers. There is an urgent need of some simple method of testing wire ropes so that incipient flaws due to cracked or broken wires may be detected as soon as possible. An ideal method for making such a test seems to be a magnetic method. Such a method of testing wire ropes is described by Dr. Wall in the *Journal* of the Institution of Electrical Engineers for July. The principle used is to employ a 'search band of magnetic flux' which is linked with a search coil system. Any flaw in the rope alters the reluctance of the circuit of the flux, and this produces a variation in the electromotive force in the search coil system which can be detected at once by a suitable recording instrument. It is therefore possible to pass the wire rope at a slow speed through the magnetic instrument, any flaws being at once shown by a change in the position of the pen of the recorder. Experimental details are given of the depth of the penetration of the alternating magnetic flux into the wire rope at different frequencies and on the effect of mechanical strain on the permeability. Experience has shown that mechanical flaws not weakening the average mechanical strength of the rope by more than about 10 per cent need not be considered, as this does not appreciably endanger its safety. It is only when more than 10 per cent of the section fails that a watch needs to be kept on the faulty section to see whether its develops further. A complete wire rope testing equipment of this type has been installed in the Hatfield Main Colliery near Doncaster. The diameter of the winding rope is $2\frac{1}{8}$ inches and the pit shaft is 860 yards deep.

Conference of Empire Meteorologists.

THE last ten days in August witnessed a meeting in London of official meteorologists from all parts of the British Empire. Ten years ago advantage was taken of the presence in London of the directors of many of the overseas observatories and services to hold a meeting for the discussion of matters of common interest, but the present is the first occasion on which invitations to send delegates to a formal conference were issued through official channels to all Dominions, Crown Colonies, and Protectorates.

The need for such a gathering has arisen from two main causes, the development of aviation and the extension of wireless as a means of communication. Long distance flying is now an accomplished fact, and the establishment of regular services between different parts of the Empire can only be a matter of time, but if they are to function with the maximum of safety and regularity, adequate meteorological services, implying close co-operation between the different meteorological authorities, are essential.

Again, the development of wireless as a means of communication has revolutionised the technique of synoptic meteorology. Ten years ago the European countries, North America, India, and Australia formed self-contained units from the forecasting point of view, and it mattered little whether there was uniformity of codes and methods. To-day all that is fast changing. The weather chart drawn each morning in the Meteorological Office now covers almost the whole of the northern hemisphere, and the maps of other services have undergone a similar enlargement of area. The consequence is considerable overlapping, which has made itself felt as a distinct inconvenience and waste of effort, more particularly in the demands made upon ships at sea. All meteorological services want reports from the oceans near their coasts, and each not unnaturally tends to impose its own hours of observation, codes, and other conventions on the ships that report to it, and it is easy to see that in such circumstances shipmasters may be embarrassed by conflicting demands. The matter is one that can be adjusted satisfactorily only by international agreement, but a survey of the position from the point of view of the British Empire will be helpful to that end.

Such were in brief the considerations which led to the calling of the Conference. It is gratifying to record that the response to the invitations was cordial. Canada (with Newfoundland) was represented by the newly appointed Director of its Meteorological Office, Mr. G. M. Patterson; India by the Director-General of Observatories, Dr. C. W. B. Normand; South Africa by Mr. C. Stewart, Chief Meteorologist; New Zealand, by Colonel D. C. Bates. Mr. A. Walter, the Director of the newly created meteorological service of the East African Group (Kenya, Uganda, Tanganyika, Rhodesia); Mr. A. J. Bamford, Superintendent of the Colombo Observatory, and Mr. T. F. Claxton, Director of the Royal Observatory of Hong-Kong, represented their respective services; and Mr. L. G. Sutton, Director of the Meteorological Service of Egypt, acted as unofficial observer for the Egyptian Government. Delegates were also sent by the following Governments, which do not, as yet, maintain meteorological services employing full-time meteorologists: Irish Free State, Somaliland, Nyasaland, Nigeria, Gold Coast, Sierra Leone, Gambia, Barbados, Windward Islands, Trinidad, Leeward Islands. Malaya, which has just started a service, was represented by Mr. J. Dewar, Assistant Surveyor-General. It is much to be regretted that Mr. H. A. Hunt, Director of the Commonwealth Weather Bureau, was not present; Captain H. J. Feakes attended on behalf of the High Commissioner to represent the Australian Service.

The proceedings opened on Tuesday, Aug. 20, at the Air Ministry, when Lord Thomson, Secretary of State for Air, welcomed the delegates on behalf of the Government. In his address he reviewed briefly the circumstances that had led up to the Conference and assured the delegates of the great importance which the Government, and more particularly the Air Ministry, attached to their work. Dr. G. C. Simpson was elected president of the Conference. The first subject to receive detailed consideration was the application of meteorology to aviation. Official visits were paid to the terminal aerodrome at Croydon and the Royal Airship Works at Cardington. At the former the delegates had an opportunity of seeing for themselves the elaborate meteorological organisation that caters for the requirements of civil flying between England and the Continent. By the courtesy of Imperial Airways, Ltd., a short flight in an air liner that afterwards left for Paris was arranged for those who wished to take part in it. At Cardington the morning was devoted to an inspection of the airship now rapidly approaching completion, and of the arrangement for mooring at the mast. During the afternoon the staff of the Meteorological Office demonstrated the special work that has been undertaken as a preliminary survey of the meteorological conditions on the England-India air route, and the researches into wind structure that have been carried out.

The discussion which occupied the two meetings held on the following day consisted in large measure of an exchange of information as to how far each Dominion or Colony could supply information of the kind shown to be necessary. The purely climatological observations to which routine work has hitherto been restricted in most Colonies require to be supplemented by observations of visibility, height and amount of low cloud, direction and velocity of upper winds obtained with pilot balloons, and if possible also of temperature in the free air as recorded by aeroplanes or by registering balloons. The exchange of ideas on methods of observation and their feasibility for use by observers in tropical countries promises to give valuable results. The suitability of the international forms for statistical summaries of these new observations for use in the special circumstances of each Colony also came up for discussion. Sub-committees were then formed to consider in detail the arrangements along various projected routes for long-distance flights.

The discussions on marine meteorology occupied three whole mornings. Technical questions of codes for wireless transmissions occupied a good deal of time, but the main questions of general interest were the use of the Hollerith machine for the statistical treatment of data from the sea and the organisation of the collection of data from ships flying the British flag. The labour of combining observations from moving observatories such as ships in statistical summaries is very great and the Hollerith system, which has been adopted by the British Meteorological Office and also by some services on the Continent, greatly reduces that labour and facilitates the exchange of observations. A visit was paid to the offices of the British Tabulating Company, where the work was demonstrated in detail. On the question of organisation, the goal to be aimed at is that each Dominion that has an office for marine meteorology should superintend the ships registered in its own ports, and that

adequate arrangements should be made for the exchange of the data between the central offices.

At other meetings the special requirements of the Army and Navy were discussed, and the arrangements that have been worked out for meeting them in Great Britain were laid before the delegates. Another important discussion centred around the arrangement under which reprints of the meteorological summaries appearing in Colonial Blue Books are supplied to the London Meteorological Office for distribution to meteorological libraries in all parts of the world. That system for rendering accessible the meteorological records of our colonies was introduced early in the century, but the present occasion has been the first opportunity for discussing it by those primarily concerned in making it a success. There was also a discussion on seasonal forecasting.

It will be observed that the subjects so far enumerated, with the exception of seasonal forecasting, concerned themselves with questions of organisation. On the last two days the meetings were of a different character. The subjects were grouped under the general heading agricultural meteorology, and the discussion was thrown open to all workers in Great Britain who co-operate in the crop-weather scheme, carried out jointly by the Ministry of Agriculture and Fisheries and the Meteorological Office, and agricultural delegates from many Colonies and Protectorates also attended. The large hall of the Civil Service Commission in Burlington Gardens was secured to accommodate the larger audience, and the details of the arrangements were made by Mr. W. R. Black of the Ministry of Agriculture. Sir Napier Shaw acted as president. The discussion covered a wide range of subjects connected with the response of crops to weather influences and a valuable exchange of views and experiences resulted. Visits to the Lord Wandsworth Agricultural College at Long Sutton, to the Royal Horticultural Society's Gardens at Wisley and to the Rothamsted Experimental Station were arranged in connexion with the Agricultural Section of the Conference.

On Friday, Aug. 24, Government hospitality was extended to the delegates at a dinner at which Mr. F. Montague, Under-Secretary of State for Air, took the chair.

Pollution and Bottom Fauna.

MR. R. E. RICHARDSON, in his paper "The Bottom Fauna of the Middle Illinois River, 1913–1925; its Distribution, Abundance, Valuation, and Index Value in the Study of Stream Pollution" (State of Illinois Department of Registration and Education, Division of Natural History Survey, Bulletin, Vol. 17, Article 12; 1928), discusses the bottom fauna of the Illinois River and its relation to pollution. These studies have been going on from 1874 until 1927 and many changes in conditions have been experienced during that time, affecting profoundly the biology of the river. The most important changes are first, the introduction in 1885 of the European carp with its rapid multiplication, its yield by 1908 to the commercial fishermen being greater than all the other fishes taken together; secondly, the completion and opening in January 1900 of the drainage canal of the Sanitary District of Chicago; and thirdly, a general movement for the reclamation of land.

The present bulletin deals with the researches of the last twelve years, based on the study of 1308 biological collections made over a stretch of 225 miles of the Illinois River and its connected bottom-land lakes. The upper part is powerfully affected by pollution which diminishes slowly downstream and varies considerably during the year, and by studying the plants and animals characteristic of septic, pollutional, sub-pollutional, and clean water an effort has been made to select an index series of species the abundance of which marks the grade of pollution in which each species predominates, the conclusion being, however, that as each series grades almost imperceptibly into another a dependable classification can only be successful by the supplementing of chemical data and a study of the dominant flora and fauna in each situation. Increase of pollution is shown by the decrease in the number of species in the bottom fauna and in the disappearance of characteristically clean-water species, also in the dissolved oxygen data which show a rapid decline from 1912 to 1920, a partial recovery occurring after the War. Together with the decrease in bottom species is a rapid increase of the sludge-worms (Tubificidæ) and midge larvæ (*Chironomus*), which multiplied enormously. A recovery in the number of the clean-water Sphæriidæ was checked and reversed by an outbreak of leeches preying on them. After prolonged floods in the summer of 1924, which probably carried down much sludge, there was a huge increase of sludge-worms, midge larvæ, and the small bivalve *Musculium transversum*, which is tolerant of pollutional conditions.

A study of competition and depredation in the more important groups shows that under clean-water conditions snails tend to dominate and to suppress midges, sludge-worms and the smaller Sphæriidæ, and sucker-mouthed fishes eat largely the smaller mollusks, midge larvæ, may-flies, and caddis flies. Only catfishes and 'sheepsheads' live on the larger snails. Thus the destruction of the snails by pollution and the consequent sparing of the small Sphæriidæ affords increased food to the coarse fish and may be of benefit to the commercial fisheries, but on the other hand the gassy taste of some of the fish and the frequently diseased condition, as in the carp, due to pollution, diminishes their market value.

The small bottom fauna recovers more slowly from pollution than the plankton of the surface layers, lagging behind the dissolved oxygen, probably because of the naturally slow rate of respread upstream of cleaner water forms, and also because of the fresh loads of incompletely oxidised organic sediment which come down with every flood. The small bottom animals, except where pollution is very heavy, thus furnish a better index of ordinary sanitary conditions than do the plankton or dissolved oxygen.

Economic Status of University Staffs in the United States.

THE learned world's earnings and spendings was the subject of a symposium, published in *Science* July 12 and 19, of papers read at meetings of the American Association for the Advancement of Science in New York last December. The budgets of university teachers are discussed under: (1) professional needs, (2) requirements of daily living, (3) necessary provision for financial security of self and family; and the conclusions reached, after a survey of statistics too meagre as a basis of generalisation but useful for clarifying the discussions, are given in the form of a tentative budget. This suggests a minimum of

10 per cent of income for (1), 15 or more per cent for (3), and about 75 per cent for (2). Professional needs (envisaged as the reinvestment in his work by a productive worker of part of his annual income to increase his productivity) are assumed to include membership in four or more professional organisations, attendance at one or two professional meetings, professional books (fifteen or more) and journals (four or more), clerical assistance, research, equipment, committees, etc., and travel for cultural purposes. Life insurance seems to be universal, but only about half of the teachers included in the statistical survey use the retirement annuity plan (5 per cent contribution from salary matched by 5 per cent from the institution), and the suggested budget allotment under head (3) is admittedly in excess of what is usual or possible among lower-grade teachers.

The course of teachers' salaries from 1914 to 1927 has been exhaustively studied, the data including reports from 302 universities and colleges concerning 15,361 teachers. The real increase since 1914, allowing for the rise in the cost of living, has been very slight, and almost two-thirds of the teachers are compelled to take on additional work to meet their economic needs, earning thus on an average 24 per cent of their regular salaries, and the higher the professional rank the greater is the economic pressure. Seventy per cent of those who do extra work do extra teaching, 25 per cent earn money by writing, 20 per cent lecture, 10 per cent do consulting work, and 25 per cent sell other services, the range of earning being from less than 100 dollars to more than 10,000 dollars, and the median 522 dollars.

A comparison has been carefully worked out of salaries in (*a*) manufacturing enterprises, (*b*) universities, (*c*) army, (*d*) navy, and (*e*) the professional and scientific grades of the U.S. Civil Service. From this we learn, for example, that 3000 dollars will buy (*a*) a young or unsuccessful salesman, (*b*) a high average assistant professor, (*c*) a young first-lieutenant, (*d*) a medium-rate ensign, or (*e*) a high assistant in professional *or* sub-professional grade.

Reviewing the facts brought out in these papers the writer of the last of the series observes: "For the future of science it is much more important that the supply of scientific workers be limited to those who can be placed at adequate salaries than it is to train or partially train large numbers and have many working for unsatisfactory salaries".

University and Educational Intelligence.

Cambridge.—The John Winbolt Prize (value about £15) for the best exercise on some subject related to the profession of a civil engineer, has been awarded to J. N. Goodier, of Downing College, and H. S. Sayles, of St. John's College, for their joint dissertation on "Some Problems of Plane Stress".

The London County Council is this winter again making provision for the continued efficiency of its teachers by arranging a comprehensive series of lectures covering all aspects of school work. A Handbook giving the titles and synopses of lectures and courses has been issued recently from the County Hall, Westminster Bridge, London, S.E.1. It is difficult to single out items for mention, but readers of Nature will be interested in the special single lectures under the heading of geography by Mr. F. J. R. Rodd on the Sahara, by Mr. J. M. Wordie on Greenland, and by Mr. A. Hamilton Rice on the Amazon. Mr. R. Phillips is giving a course on weather study in schools. The mathematical section includes a course on school geometry by Prof. T. P. Nunn and another by Mr. W. C. Fletcher on the teaching of mathematics; there are also courses on psychology in relation to school work. Science in boys' and in girls' schools is dealt with in other courses, Dr. R. S. Clay is giving a course on recent developments in physics, and Prof. C. R. Darling another on electricity in the home. Science teachers are also offered tickets of admission to the meetings of several scientific societies. The fees for teachers working in London, Croydon, Kent, or Middlesex average less than 1*s.* a lecture.

The Loughborough College Calendar for 1929–30 gives particulars of courses in its two faculties, engineering and pure and applied science (including chemical technology), in its junior department (a public secondary school designed to meet the requirements of boys wishing to enter engineering professions), and in its school of industrial and fine art. A distinctive feature of its engineering courses is that theoretical and practical training is given concurrently. Its workshops being equipped for producing all types of engineering components upon a productive basis, the student is able to complete his training without seeking practical experience in outside engineering works. The College diploma in mechanical, electrical, or automobile engineering involves five years of residence, in civil engineering four years, and in commercial or chemical engineering or chemical technology three years. Five open British Empire scholarships in the faculty of engineering, worth £75 per annum, for the period of the full diploma course, are awarded annually. These have drawn students from many parts of England and three from overseas. The College has a department of extramural adult education with staff tutors in economics, literature, political science, and psychology, controlled by a sub-committee of the Nottingham University College Joint Committee for Tutorial Classes.

From the Carnegie Endowment for International Peace we have received a copy of the annual report on its Division of Intercourse and Education. The divisional director, Dr. Nicholas Murray Butler (who is also president of the Endowment) summarises in 92 pages the many-sided activities whereby, at a cost during 1927–28 of 378,869 dollars, it has been making its influence increasingly felt in almost every country in the world. Its largest single undertaking was a two-months visit by fourteen British journalists to the United States as its guests. This cost 60,000 dollars. An equal amount was devoted to the maintenance of and work through its "Centre Européen" at Paris, including its official organ, the quarterly review, *L'Esprit International*. Large sums were also devoted to reorganising, with the aid of a group of American librarians, the colossal Vatican library, and to the expenses of a scheme for the appointment of visiting professors of international relations. Some fourteen professors of various subjects in American universities who happened to be visiting foreign countries for their own purposes accepted appointment as Carnegie professors for the delivery of a few public or academic lectures and for series of intimate conferences and discussions with professors and advanced students. Two others, Dr. David P. Barrows of California and Dr. Henry Suzzallo of Seattle, visited respectively the Latin-American States and central Europe entirely under the auspices of the Endowment. Among numerous subventions of enterprises deemed valuable as agencies for fostering international goodwill and understanding was a grant of 5000 dollars towards the expenses of delegates of the principal entomological societies of Europe attending the fourth International Congress on Entomology at Cornell University.

Calendar of Patent Records.

September 14, 1815.—The metronome, as it is known to-day, was patented in France on Sept. 14, 1815, by J. N. Mälzel of Ratisbon, who was a friend of Beethoven and a well-known mechanician who toured through Europe with various automata and a mechanical orchestra of his own devising. His right to be called the inventor of the metronome was denied by the Dutch Academy in favour of the Dutchman Winkel, but it was Mälzel who set up the first factory for its manufacture in Paris in 1816.

September 15, 1594. — On Sept. 15, 1594, a Venetian patent for twenty years was granted to Galileo for a machine for raising water and irrigating land which, with the motive power of a single horse, would continuously discharge water through twenty spouts. Nothing is known of the machine, but the patent is interesting as showing the similarity of the early Venetian and English patent practice. The extant documents include (1) a petition from Galileo to the Doge for the grant of a privilege for forty years for his invention "found by me at great trouble and expense", (2) a request from the Council for a report on the petition from the "Provveditori di Commun", (3) the report recommending a grant for twenty years, (4) the Council's approval of the report and (5) the grant of the Doge, with a stipulation that Galileo was to construct a machine within one year.

September 15, 1806.—Joseph Manton's double-barrel shot-gun with elevation top-rib was patented on Sept. 15, 1806. Manton was the most celebrated British gunsmith of the first half of the nineteenth century. He took out several patents, but his deservedly high reputation was due more to his excellent workmanship than to his inventions, which, with the litigation to which they led him, absorbed all his profits and left him bankrupt at the end.

September 15, 1902.—The Owens' bottle-making machine, in which the manufacture is entirely automatic from the raw material to the finished bottles, was patented in England by the Toledo Glass Co., of Ohio, on Sept. 15, 1902. The first successful bottle-blowing machine had been invented by the Englishman Ashley in 1888, but this and the many machines that followed had to be supplied with the molten glass by hand, and they were not extensively used.

September 18, 1863.—Nitro-glycerine was first made by Sobrero in 1846, but it was Alfred Nobel who brought it into practical use as an explosive, the first patent—for a mixture of nitro-glycerine and gunpowder—being granted to him in France on Sept. 18, 1863. He started manufacture on a commercial scale in 1862 at Helleneborg, near Stockholm, and not even a disastrous explosion, when his younger brother lost his life and the works were destroyed, discouraged him from continuing his researches. The danger in handling the new explosive, which greatly restricted its use for some time, was removed by Nobel's invention of dynamite (see Calendar of Patent Records, July 8).

September 20, 1849.—An early instance of electro-metallurgy is supplied by the patent granted to W. E. Staite and William Petrie on Sept. 20, 1849, for various improvements in the construction and use of the electric battery. A process for fusing iridium is described, in which are employed a bed of iridium powder about $\frac{1}{2}$ in. thick, supported on a copper slab connected to the positive terminal of a battery, and a solid iridium electrode connected to the other terminal. The electrode is brought gently into contact with the top of the powder and immediately withdrawn about $\frac{1}{8}$ in., and then moved horizontally to and fro along the top of the powder, whilst the arc plays between it and the powder.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting at Düsseldorf), Sept. 9.—**A. G. C. Gwyer** (Autumn Lecture): Aluminium and its alloys (in German). A short account was given of recent work to improve the general reliability of aluminium and its alloys, more particularly from the points of view of soundness and resistance to corrosion. The constitution of the alloys, and of the metal itself, was discussed. Heat treatment of aluminium alloys also received attention. The lecture concluded with a short account of the application of the methods of X-ray spectrography to aluminium.

Sept. 10.—**Walter Rosenhain**: Some methods of research in physical metallurgy. A description of methods developed in recent years, and particularly in the Metallurgy Department of the National Physical Laboratory, especially in connexion with the determination of equilibrium diagrams. A brief account is given of a novel form of electrical dilatometer, making use of measurements of the capacity of a small condenser which is varied by the dilatation of the specimen. In optical pyrometry, a novel method of securing black body conditions, by sighting upon the interior of a gas bubble blown in a mass of molten metal, is described. In work on structure it is necessary to secure a high degree of purity of the metal and special refractories have been developed.—**G. Masing**: Methods of research in metallography. Researches on the constitution of alloys must be based on the well-established thermodynamical laws of heterogeneous equilibria. The experimental methods need to be improved in precision and amplified (especially X-ray technique). The most important improvement required is the development of a method for the rapid attainment of equilibrium in an alloy. The study of constitution also demands an investigation of the condition of alloys far removed from the state of equilibrium; theoretical and experimental aspects of this problem are considered.—**P. Chevenard, Portevin, and X. F. Waché**: A dilatometric study of some univariant two-phase reactions. The reactions in quenched aluminium-copper and aluminium-silicon alloys, when annealed at various temperatures. Alloys of iron, nickel, and copper have also been investigated by means of the dilatometer, and the boundary of the two-phase field on the iron side of the system has been determined.—**Mas Haas and Denzo Uno**: An improved differential-dilatometer. The accuracy of Chevenard's optical differential-dilatometer has been improved by mounting the apparatus on a triangular rail, by using one dilatometer tube instead of two, and by replacing the spring that holds the mirror by a magnet coil arrangement. Provision is made for working in any special atmosphere.—**W. H. J. Vernon and L. Whitby**: The open-air corrosion of copper: a chemical study of the surface patina. In general, the green patina consists essentially of basic copper sulphate. An exception is the product from a purely marine atmosphere, in which basic copper chloride predominates; where urban and marine conditions coincide, however, then basic sulphate greatly predominates. Basic copper carbonate enters only to a minor extent into the composition of the product, even in rural districts remote from sea and town. Sulphur compounds, derived from products of combustion and disseminated by wind, are the most potent agents in the development of patina. The underlying metal, after long periods of exposure, shows remarkable freedom from pitting.—**C. O. Bannister**: Studies on the crystallisation of gold from the liquid state. Different methods are given of preventing undercooling and 'flashing'.

formation of straight boundary lines by the interference of radial growth from two, three, and four nuclei, and the formation of curved boundary lines by retardation of growth from one centre are illustrated.—**A. Glynne Lobley** and **C. L. Betts**: The creep of 80 : 20 nickel-chromium alloy at high temperatures. Wires 0·018 in., 0·0625 in., and 0·25 in. thick were subjected to tensile stresses of 50, 100, 200, and 400 lb. per in.^{2} at temperatures of 700°, 800°, 900° and 1000° C. for a period of approximately 4000 hours. The rate of flow was found to be dependent on the diameter of the wire as well as on other factors.

PARIS.

Academy of Sciences, July 29.—**Charles Moureu, Charles Dufraisse**, and **Paul Gagnon**: Researches in the phenylindene series. The extension of Wolff's reaction to the direct preparation of a hydrindenic hydrocarbon starting from the corresponding ketone.—**Charles Richet** and **Michel Faguet**: The action of sea water in extremely small amounts on fermentation. Sea water in the concentration of 10^{-10} per cent still exerts a definite action on the lactic fermentation.—**Gabriel Bertrand** and **Mlle. Voronca-Spirt**: Titanium in animals. As a result of experiments on twenty species of animals, it is concluded that titanium exists in animals, but in proportions varying with the organ and species. Exceptionally, no titanium could be detected in organs of the rabbit, but a relatively high proportion was found in the hair of this animal.—**Charles Nicolle, Charles Anderson**, and **Jacques Colas-Belcour**: The relations between the recurrent Moroccan spirochæte *Sp. hispanicum var. marocanum* with the porcupine.—**Paul Delens**: The properties of certain families of curves.—**N. Lusin**: The semiregular parametric representation of ensembles.—**P. L. Srivastava**: The singularities of a class of Dirichlet's series.—**Radu Badesco**: An integral equation.—**André Marcelin**: Surface coatings on water and molecular dimensions. The direct determination of the thickness of a film in a state of saturation is frequently impossible on account of the solubility. The author outlines a method for avoiding this difficulty.—**Fahir Emir**: Superficial solutions and molecular films. The study of some substances and the determination of the lengths of their molecules. Data are given for palmitic and stearic acids and for cetyl alcohol. Applying the rule given by A. Marcelin to these data, the lengths of the molecules found agree closely with those determined by X-ray methods.—**Jean Guastalla**: Superficial solutions of oleic acid. Measurement of very low pressures. Development of the methods of André Marcelin, with details of some improvements in detail.—**D. Chalonge** and **Ny Tsi Zé**: The continuous spectrum of the hydrogen atom. Details of the changes in the hydrogen spectrum produced by passing from discharge without a condenser to the condensed discharge. Curves are given showing the changes produced in the intensity of the radiation as a function of the wave-length for four types of discharge.—**. Loiseleur**: The ballistic effect exercised by thin polished metallic plates.—**Severiano Goig**: The compressibility of carbon monoxide at 0° C. above 50 atmospheres. Details of methods of preparation and purification of the carbon monoxide used are given; an accuracy of 0·02 per cent is claimed for the results. Over the range of pressures obtained in the experiments, the values of pv for carbon monoxide are lower than those for nitrogen. The minimum pv for nitrogen at 0° C. is 72 atmospheres, for carbon monoxide at the same temperature, 90 atmospheres.—**Albert Portevin** and **François Le Chatelier**: High temperature tests on metals and alloys by compression and by wire drawing.—**Arakel Tchakirian**: Basic acetate and basic sulphate of gallium and gallium oxalate. The preparation of the basic gallium salt

$$4Ga(CH_3CO_2)_3 \cdot 2Ga_2O_3 \cdot 5H_2O$$

is described. Aluminium, zinc, indium, and iron do not form basic acetates under similar conditions, and hence the compound serves as a means of separating gallium.—**Joseph Robin**: Researches in the rubrene series. Nitrogen compounds obtained starting with the chloride of diphenyl phenylethinyl carbinol, $(C_6H_5)_2CCl \cdot C \equiv C - C_6H_5$. Study of the products of the reaction of this chloride with ammonia and with aniline.—**Pierre Bedos**: The retrogradation of the C_6 ring into the C_5 ring with the aid of the etherate of magnesium bromide. It is shown that in the reaction between organo-magnesium compounds and cyclohexene oxide or chlorhydrin, the C_6 ring passes into a C_5 ring, with transitory formation of cyclopentane aldehyde.—**Couvreur**: The brechoid chalk of Plaisir (Seine-et-Oise).—**Henri Termier**: The Devonian of Tafilalet.—**Alfred Carpentier**: The fructifications of *Rhodea Gutbieri*.—**D. Chouchak**: The struggle between cultivated plants and the soil micro-organisms for their mineral nutrition: the action of dried blood on phosphate manure.—**J. Régnier**: Measurements of the activity of cocaine hydrochloride on different nerve trunks.—**Ernst A. H. Friedheim**: Concerning the oxidation-reduction potential of the tissues of mammals.

CAPE TOWN.

Royal Society of South Africa, July 17.—**John P. Dalton**: On integrating factors and Jacobi's equation. The author's method of the 'common integrating factor' is applied to Jacobi's equation, and the general solution is thereby obtained. By means of the linear integrals and what are called parallel loci, the relations of the integral curves to the singularities are discussed for all types of root of the characteristic cubic.—**E. N. Grindley**: A new method of observing diurnal variation of magnetic intensity and declination, using field instruments. The principal sources of error in the 'deflection' method of obtaining diurnal variation curves are eliminated or considerably reduced by using the method of timing vibrations of the long magnet of an ordinary magneto-meter. A routine was described by which H and D can be simultaneously measured (and the results computed) in less than twenty minutes, the accuracy being estimated at 5 gamma units.

Official Publications Received.

BRITISH.

The Indian Forest Records. Economy Series, Vol. 14, Part 1: The Burma Bamboo Pulp Survey. By W. Raitt. Pp. 8+48+9 plates. (Calcutta: Government of India Central Publication Branch.) 2.10 rupees; 4*s.* 9*d.*

Memoirs of the Queensland Museum. Edited by Heber A. Longman. Vol. 9, Part 3. Pp. iv+207-363+plates 27-35. (Brisbane.)

Empire Marketing Board. Note on the Work and Finance of the Board and Statement of Research and other Grants approved of by the Secretary of State for Dominion Affairs from July 1926 to March 31st, 1929. (Cmd. 3372.) Pp. 31. (London: H.M. Stationery Office.) 9*d.* net.

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1928. Pp. 13. (Birmingham.)

Board of Control (England and Wales). General Paralysis and its Treatment by Induced Malaria. By Surgeon Rear-Admiral E. T. Meagher. Pp. 88. (London: H.M. Stationery Office.) 2*s.* net.

Union of South Africa: Fisheries and Marine Biological Survey. Report No. 6 for the Year ending June 1928; and Special Reports. By Dr. Ceal von Bondé. Pp. 71+36+7+5+21+11+11 plates. (Pretoria: Government Printing and Stationery Office.)

Records of the Botanical Survey of India. Vol. 12, No. 11: The Forests of Kalimpong; an Ecological Account. By Dr. J. M. Cowan. Pp. ii+74+2 plates. (Calcutta: Government of India Central Publication Branch.) 3.8 rupees; 6*s.*

Trinidad and Tobago. Council Paper No. 52 of 1929: Administration Report of the Conservator of Forests for the Year 1928. Pp. 20+2 plates. (Trinidad, B.W.I.: Government Printer, Port-of-Spain.) 8*d.*

The Hundred and Seventh Report of the Commissioners of Crown Lands. Pp. 35. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

Mines Department. Publications of the Safety in Mines Research Board, Vol. 3, 1927: Reports and Papers relating to Research into Coal Dust, Firedamp and other Sources of Danger in Coal Mines. Pp. 11. (London: H.M. Stationery Office.) 2*d*. net.

Department of Public Instruction: Technological Education Branch, New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1928. Pp. 5. (Sydney, N.S.W.)

Department of Agriculture: New South Wales. Science Bulletin No. 33: Veterinary Research Report No. 4. By Dr. H. R. Seddon. Pp. 106. (Sydney, N.S.W.: Alfred James Kent.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 42: A Soil Survey of Block E (Renmark) and Ral Ral (Chaffey) Irrigation Areas. By J. K. Taylor and H. N. England. Pp. 51+1 plate. (Melbourne: H. J. Green.)

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 7, July 1929. Abstracts Nos. 1280-1560. Pp. v+249-285. (London: H.M. Stationery Office.) 9*d*. net.

Bulletin of the Madras Government Museum. New Series, Natural History Section, Vol. 2: The Flowering Plants of Madras City and its Immediate Neighbourhood. By P. V. Mayuranathan. Pp. 345+38 plates. (Madras: Government Press.) 8 rupees.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 24, No. 1. Pp. 175+8 plates. New Series, Vol. 24, No. 2. Pp. 165. (Calcutta.)

Mysore Geological Department. Bulletin No. 10: Report on the Copper Ore Deposits of Ingaladhal, near Chitaldrug. By A. M. Sen and B. Rama Rao. Pp. v+15+3 plates. (Bangalore: Government Press.) 1 rupee.

Indian Lac Association for Research. Reports of the Committee and of the Director, Indian Lac Research Institute, Nankum, Ranchi, for the Year 1st April 1928 to 31st March 1929. Pp. ii+32. (Calcutta.)

Union of South Africa: Department of Agriculture. Bulletin No. 51: Further Citrus Canker Studies. By E. M. Doidge. Pp. 31. (Pretoria: Government Printer.) 3*d*.

Annals of the South African Museum. Vol. 27: The Stone Age Cultures of South Africa. By A. J. H. Goodwin and C. Van Riet Lowe. Pp. ix+289+45 plates. (Cape Town.) 25*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1223 (Ae. 378): On the Two-Dimensional Flow past a Body of Symmetrical Cross-section mounted in a Channel of Finite Breadth. By A. Fage. (T. 2720.) Pp. 12+5 plates. 9*d*. net. No. 1232 (Ae. 387): On the Maximum Load in Pulling out from Vertical Dives. By S. B. Gates and H. B. Howard. (T. 2722.) Pp. 9+2 plates. 9*d*. net. No. 1240 (Ae. 395): Rolling and Sideslip Experiments on a Model Slotted Biplane of R.A.F. 31 Section. By H. B. Irving, A. S. Bateson and A. L. Maidens. (T. 2737.) Pp. 5+14 plates. 6*d*. net. (London: H.M. Stationery Office.)

Proceedings of the South-Western Naturalists' Union. Edited by Dr. F. S. Wallis. Vol. 2, Part 2, August. Pp. 21-48. (Bristol.)

The Cordwainers Technical College, Eagle Court, St. John's Lane, London, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1929–1930. Pp. 42. (London.)

FOREIGN.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 597-B: A Study of Ground Water in the Pomperaug Basin, Connecticut, with Special Reference to Intake and Discharge. By Oscar Edward Meinzer and Norah Dowell Stearns. (Contributions to the Hydrology of the United States, 1928.) Pp. iv+73-146+plates 11-19. 35 cents. Water-Supply Paper 597-D: Geology and Water Resources of the Upper McKenzie Valley, Oregon. By Harold T. Stearns. (Contributions to the Hydrology of the United States, 1928.) Pp. ii+171-188+plates 21-23. Water-Supply Paper 636-A: Quality of Water of the Colorado River in 1926–1928. By C. S. Howard. (Contributions to the Hydrology of the United States, 1929.) Pp. ii+14. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Professional Paper 154-F: Water-Laid Volcanic Rocks of Early Upper Cretaceous Age in Southwestern Arkansas, Southeastern Oklahoma and Northeastern Texas. By Clarence S. Ross, Hugh D. Miser and Lloyd W. Stephenson. (Shorter Contributions to General Geology, 1928.) Pp. iv+175-202+plates 18-27. 25 cents. Professional Paper 154-G: Algae Reefs and Oolites of the Green River Formation. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1928.) Pp. ii+203-223+plates 28-48. Professional Paper 154-H: A Revision of the Flora of the Latah Formation. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1928.) Pp. ii+225-265+plates 49-64. 30 cents. Professional Paper 154-I: *Exogyra olisiponensis* Sharpe and *Exogyra costata* Say in the Cretaceous of the Western Interior. By John B. Reeside, Jr. (Shorter Contributions to General Geology, 1928.) Pp. ii+267-278+plates 65-69. 10 cents. Professional Paper 154-J: Additions to the Flora of the Green River Formation. By Roland W. Brown. (Shorter Contributions to General Geology, 1928.) Pp. ii+279-299+plates 70-76. 20 cents. Professional Paper 157: The Mother Lode System of California. By Adolph Knopf. Pp. viii+88+12 plates. 55 cents. (Washington, D.C.: Government Printing Office.)

Field Museum of Natural History. Geological Series, Vol. 4, No. 5: Contributions to Paleontology. By Sharat Kumar Roy. (Publication 254.) Pp. 199-220+plates 32-40. Zoological Series, Vol. 12, No. 18: A Contribution to the Ornithology of Northeastern Brazil. By Charles E. Hellmayr. (Publication 255.) Pp. 233-501+plate 22. Report Series, Vol. 7, No. 3: Annual Report of the Director to the Board of Trustees for the Year 1928. (Publication 256.) Pp. 377-600+plates 42-61. Zoological Series, Vol. 17, No. 1: The Birds of the Neotropical Genus Deconychura. By John T. Zimmer. (Publication 257.) Pp. 18. (Chicago.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 7: Accredited Higher Institutions, 1927–1928. By Ella B. Ratcliffe. Pp. v+56. (Washington, D.C.: Government Printing Office.) 10 cents.

Methods and Problems of Medical Education. (Thirteenth Series.) Pp. 130. (New York City: The Rockefeller Foundation.)

Anales del Museo Nacional de Historia Natural Bernardino Rivadavia. Tomo 34. Pp. x+601. (Buenos Aires.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 28, Part 1: The North American Species of Paspalum. By Agnes Chase. Pp. xviii+310. (Washington, D.C.: Government Printing Office.) 70 cents.

CATALOGUES.

X-Ray News and Clinical Photography. Vol. 1, No. 7, June. Pp. 81-92. (London: Kodak, Ltd.)

Fluorescence Analysis. The Instant Test of Raw Materials for Grade and Genuineness: The Proof of Validity for Cheques, Notes and Securities, Paintings, Rare Stamps, etc. Pp. 20. (London and Slough: The British Hanovia Quartz Lamp Co., Ltd.)

Man through the Ages: his Origin, Customs and Beliefs; a Catalogue of Books on Anthropology, Folklore and Early Civilizations, including Ethnography, Mythology, Magic, Totemism, Witchcraft, etc. (No. 517.) Pp. 76. (London: Francis Edwards, Ltd.)

New Instruments of Great Rapidity for Measuring Radiation, designed by Moll and Burger. (VLU. 29.) Pp. 4. The Moll Micro Galvanometer. (Migalv. 29.) Pp. 2. Zernike Thermopile. (Gezu. 29.) Pp. 2. The Moll Recording Microphotometer. (MF. 29.) Pp. 11. (Delft: P. J. Kipp en Zonen.)

Diary of Societies.

TUESDAY, SEPTEMBER 17.

IRON AND STEEL INSTITUTE (in Secondary Schools, Doncaster Road, Scunthorpe), at 6.30.—Discussion on following papers: Notes on the Damping-down and Re-starting of Blast-Furnaces, C. S. Gill; High Elastic Limit Structural Steels, J. A. Jones; The Hardness of Vacuum-Annealed Crystals of Iron, H. O'Neill.

WEDNESDAY, SEPTEMBER 18.

CERAMIC SOCIETY (Refractory Materials Section) (at Midland Grand Hotel, St. Pancras), at 10 A.M.—G. Lavelle: Drying Clay Goods.—H. Pardoe: Hot Patching.—J. M. Coon: Micro-structure of Silica Building Bricks.—Dr. G. Martin: Thermal Inefficiency of Rotary Kiln.—Dr. C. Sykes: Molybdenum Wirewound Furnaces.—(Building Materials Section), at 10 A.M.—G. Lavelle: Drying Clay Goods.—At 10.45.—L. G. Tomlinson: Some Different Methods of Fixing Roofing Tiles and their Influence on Tile Lamination.—J. Procter: Mechanical Stoking of Kilns.—L. F. Cooling: A Contribution to the Study of Fluorescence: The Evaporation of Water from Brick.

THURSDAY, SEPTEMBER 19.

CERAMIC SOCIETY (Refractory Materials Section) (at Midland Grand Hotel, St. Pancras), at 10.15 A.M.—S. R. Hind and F. Wheeler: Effect on Non-plastics on Shrinkage.—G. T. Harley: Scientific Shovelling.—F. West: Notes on American Trip.—(Building Materials Section), at 10 A.M.—E. Simpson: The Value of a Laboratory to a Clayworks Manager.—I. Lubbock: Oil Fuel and the Brick Industry.—Facing Bricks, Road Paving Bricks, and Roof Tiles, as Manufactured in the State of Ohio, U.S.A.—At 11.30.—F. West: Notes on American Trip.

CONFERENCES.

SEPTEMBER 16 AND 17.

BIBLIOGRAPHIQUE INTERNATIONALE (at Imperial College of Science).

Monday, September 16.—Council Meetings.

Tuesday, September 17, at 10 A.M.—Prof. A. F. C. Pollard: Presidential Address.

The agenda will include Further Proposals for the Reorganisation of the Institute, Reports of the Commissions on Cataloguing Rules and on Documentary Technique, and a Discussion on the Possible Unification of the Aims and Objects of International Bibliographical Organisations.

SEPTEMBER 20–23.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).

Friday, September 20, at 6.45.—Reception of Delegates by the Council of the Association.

At 7.15.—Dinner. Address by Sir J. J. Thomson, the President elect.

At 8.30.—Brig.-Gen. M. Mowat: The Year's Work of the Association.—Laurie Magnus: The Approach of the Producer to the Consumer of Information.

Saturday, September 21, at 10 A.M.—S. H. Hamer: The Preservation of Places of Natural Beauty and Historic Interest.—A. Parker: Duplicating Machinery: A Survey of Modern Methods.—E. J. MacGillivray: Duplication, and Infringement of Copyright.—Dr. W. Bonser: The Ideal Form of a Journal from the Librarian's Point of View.

At 5.30.—Annual General Meeting.

At 8.30.—G. T. Hankin: Books versus Text-books, the Problem of the Schools.—R. A. Austen-Leigh: Organised Information in the Printing Trade.—E. W. Ashcroft: Technical English.—E. Green: The Information Service of a Public Library.—P. A. Green: The Information Service of a Bank.

Sunday, September 22, at 10 A.M.—A. F. Ridley: The Training of Special Librarians.—H. Rottenburg: Indexing and Classifying of Individual Collections of Data.—A. P. L. Gordon: Sources and Application of Business Data.—E. T. Elbourne and H. G. T. Cannons: An Indexing System for Published Business Information.

At 8.30.—P. Otlet: International Organisation of Information Services.

NATURE

SATURDAY, SEPTEMBER 21, 1929.

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Colonial Development and the Scientific Worker.

ANYBODY who troubles to read the official reports of the debates which took place during the last session of Parliament would be struck by the continual references made to the importance of scientific research. The subjects upon which the debates centred, for example, industrial development in Great Britain, colonial development, and others which it is hoped will provide a solution to our unemployment problem, are not new. The principal protagonists in Parliament of scientific research have not changed, although their arguments have gained point and emphasis because scientific workers in recent years have proved themselves by the results they have obtained over a large field of endeavour. What is novel is the hold which science now has upon the imagination of a large number of rank and file members of both Houses of Parliament. Their critical interest in scientific research is one of the happiest auguries for the future.

When Mr. Thomas introduced the Colonial Development Bill, he occasioned some surprise by including in its clauses one providing for the encouragement of scientific research. It has been assumed for some time past that all schemes for the prosecution of scientific research in the colonial empire, other than those promoted by the colonies themselves, were covered by the activities of the Empire Marketing Board, which it will be remembered was set up in 1926 as a direct result of the recommendations of the Imperial Economic Committee. Some members feared that the introduction of this clause might lead to unnecessary overlapping between the Empire Marketing Board and the Committee which Mr. Thomas promised would be appointed to deal with the allocation of the funds provided by this new Bill. They expressed the fear also that since the expenditure under the new Bill was to be controlled by an annual vote of Parliament, and that any unexpended balances in one year could not be carried over to the next, that Mr. Thomas had been unduly influenced by those critics, including the Treasury, of the Empire Marketing Board who are still unconvinced of the desirability of providing funds for statutory bodies to enable them to consider long-range schemes in connexion with research and technical development. That their fears were justified was evident from Mr. Thomas' subsequent declaration that he proposed to bring the Empire Marketing Board funds under statutory control, a distinct reversal

of the method of administration of the funds at its disposal.

Lest the objections of Mr. Amery, Mr. Ormsby-Gore, Major Church, and others interested in the application of science to colonial development should be considered trivial by scientific workers unfamiliar with the machinery of State, it should be explained that a Parliamentary grant to a body for specified purposes differs greatly from a statutory grant. The former gives comparative freedom to those appointed to administer the grant to apply the funds at its disposal without constant reference to and sanction by the Treasury: a statutory grant involves Treasury control over every item of expenditure, and Treasury sanction of every scheme put forward by those theoretically charged with the administration of the funds annually voted by Parliament. Whatever may be the merits of this form of administration for most forms of State expenditure, it is not calculated to assist those responsible for the initiation of research and development schemes. Such schemes may involve financial commitments over a term of years, not infrequently they will not come to maturity for years, and the administering body must take these factors into account. It is obviously best able to do so if its unexpended balances at the end of a financial year can be carried over from one year to the next, instead of being returned to the Sinking Fund.

The fact that scientific workers as a whole registered no protest against what can only be considered as a retrograde act on the part of Mr. Thomas, is merely indicative of their apathetic lack of interest in the assembly which has so great an influence on their work. To this same cause can be attributed the absence of any scientific worker on the committee appointed by Mr. Thomas to administer the Colonial Development Fund, in spite of his declaration that this committee would be entrusted with the task of co-ordinating its own programme of research with that of the Empire Marketing Board. Were the debates in Parliament not fully reported, had scientific workers not been given so striking a lead by Mr. Amery in his speech on July 12 when he pleaded eloquently that the committee which Mr. Thomas proposed to appoint should not consist purely of eminent business men with a business chairman, their indifference to measures calculated to have a tremendous effect on the future of scientific research might be excused. Were the contributions already made by science to civilisation in general and colonial development in particular of small account, or were those scientific workers in the colonies adequately rewarded and given other forms of recognition commensurate with those of other professional workers, there might be some justification for their attitude of aloofness. But in present circumstances there is neither justification nor excuse for it. They may dislike and distrust politicians as a class, but they must realise that in our politicians is vested the power to vote the moneys necessary for all public services at home and in the colonial empire. Politicians reflect public opinion. They are most susceptible to the influence of the better-educated sections of the public, provided those sections are vocal.

In recent years successive Governments have appointed committees to deal with an extensive variety of subjects upon which scientific workers could speak with authority. There was a most important committee on industry and trade appointed in 1924 by Mr. Sidney Webb (now Lord Passfield). Its deliberations were spread over years. At various stages of its inquiries it consulted scientific experts. But no scientific worker was appointed to the committee, which means that no scientific worker was able to exercise any great influence on the committee's final recommendations. The same thing is true of the last Royal Commission on the Coal Industry. This Commission was assisted by scientific assessors, but science was not officially represented on the main body. Science, it might be assumed, might have had some real contribution to make to the recent deliberations of the Cotton Arbitration Committee. But its representatives and there are many actively engaged in the industry do not appear to have been consulted. Apart from Government committees there is another field which might reasonably be expected to engage the attention of scientific workers. For nearly two years past a committee has been sitting composed of representative employers, *e.g.* Lord Melchett, Lord Ashfield, Sir Robert Hadfield, and representatives of the Trade Unions. Had scientific workers as a body asked to be represented at this industrial conference, it seems reasonable to assume that they would have been welcomed. No such approach has been made.

It remains to be seen whether scientific workers will avail themselves of the opportunity to take a more active part in Imperial affairs which is afforded them by the recent formation of a Parliamentary Science Committee. This committee which already numbers more than seventy members of the House of Commons, has been formed for the purpose of discussing the bearing of science on politics. Such matters as the wilful or unintentional omission of representatives of science from the Colonial Development Committee would come within its scope. Further, the Parliamentary Science Committee, being non-party, would probably be the best venue in which preliminary discussions could take place on the scope of scientific research as applied to the social as well as the economic development of our tropical Empire.

Epidemic Diseases.

(1) *Epidemiology Old and New.* By Sir William Hamer. (Anglo-French Library of Medical and Biological Science.) Pp. x + 180. (London: Kegan Paul and Co., Ltd., 1928.) 9*s.* net.

(2) *Common Colds: Causes and Preventive Measures.* By Leonard Hill and Mark Clement. Pp. viii + 126 + 6 plates. (London: William Heinemann (Medical Books), Ltd., 1929.) 7*s.* 6*d.* net.

(3) *Les ultravirus et les formes filtrantes des microbes: les maladies à ultravirus, leurs caractères cliniques, anatomopathologiques, épidémiologiques, l'immunité, techniques d'étude des ultravirus, les formes filtrantes des bactéries.* Par Dr. Paul Hauduroy. Pp. 392. (Paris: Masson et Cie, 1929.) 40 francs.

THE work of the nineteenth and of the present century has achieved much in the prevention of disease, but there are many maladies which still baffle public health endeavour. Of these, perhaps the most formidable are the great group of respiratory diseases, including influenza. Annually, few persons escape their attack, if merely in the form of the 'common cold', and the winter mortality figures for pneumonia impress the sad truth that this disease is not only "the friend of the aged", but also puts a premature end to the lives of the young. The three books before us are concerned with this subject in greater or lesser degree, and each of them attacks the problem at a different angle.

(1) Sir William Hamer's scholarly treatise, which embodies his teaching and medical philosophy, claims premier place; for Sir William is the protagonist of the new epidemiology, which in its essentials is the oldest epidemiology. Thomas Sydenham is its patron saint, and its motto is "that there is nothing new under the sun".

Sydenham's work on epidemics may be summed up as follows:—

(i) Certain fevers, he observed, had an epidemic character which bred true; they were of constant type year after year, or, as he puts it, "they were regular and uniform with the same phenomena and a general conformity of symptoms".

(ii) Variations occurred. The same disease, he believed, manifested itself with various dissimilar aspects as to origin, formation, decline, "like a monarch with a bodyguard of foreigners".

(iii) Both typical and atypical fevers prevailed at certain times, dependent, he considered, upon meteorological or atmospheric conditions or other external influences.

(iv) When several fevers infested the same period, one of them had an ascendancy over the others. When the paramount malady increased they declined; when it decreased they increased. The disease or symptoms which predominated determined the 'epidemic constitution' of that season, and thus there were different epidemic constitutions in different periods with a counterpart seasonal predisposition in the human constitution.

(v) Some epidemic constitutions were secular in length, long-period, and others were short and seasonal.

Sydenham's doctrine of epidemics, as has often been remarked, accords with the views of Hippocrates concerning the epidemics in the island of Thasos in the fifth century B.C. Sir William Hamer gives the doctrine the weight of his authority and the value of a modern interpretation. In the first chapter he describes the recent influenzas from 1915 to 1925 and maintains the thesis that cerebro-spinal fever, epidemic encephalitis, poliomyelitis, and the hosts of ills that have vexed mankind in recent years, are old foes with new faces, walking in the wake of influenza and part of an epidemic constitution. After discussing the contrasts and resemblances of London epidemics in the time of Sydenham and at the present day, and considering the history of epidemiology during the last hundred years, he elaborates his argument from a wealth of experience, and after pointing out that bacteriology has not been sufficiently careful in distinguishing causal from associated organisms, he leads the reader back in the concluding chapters to the starting-point, to Hippocrates and Sydenham. It would have been preferable for the findings of clinical medicine, pathology, and bacteriology to have received more weight in the discussion. It can scarcely be true that secondary organisms have so frequently led bacteriologists astray as the author would postulate.

Sir William Hamer's book is a fine exposition of certain epidemiological beliefs. While his interpretations of disease outbreaks may not receive unanimous acceptance, they must be weighed and considered by every serious student of epidemiology.

(2) The failure of the medical profession to cure a cold is a common grievance of the laity. Dr. Leonard Hill, with Mr. Mark Clement, has done his best to remove this reproach. The problem is dealt with exhaustively in the light of Dr. Hill's well-known physiological investigations. The authors conclude that "if cold weather gives rise to an epidemic of 'colds' the cause is not to be

sought in meteorological conditions, but rather in crowding in overheated and stuffy rooms, in ill-feeding and in 'coddling'". The high incidence of illnesses spread by 'droplet' infection in crowded dormitories and the low incidence in open-air schools afford ample testimony to the value of the simple preventive measures detailed in this book.

(3) Common colds and influenza are believed by many authorities to be due to ultra-microscopic viruses. In the volume entitled "Les ultravirus et les formes filtrantes des microbes", Dr. Paul Hauduroy has assembled a collection of knowledge upon this subject which marks a new chapter in the record of bacteriology. Dr. Hauduroy is less critical than informative. The treatise is one which the investigator will consult to learn to what extent others have travelled on the road before him. At the same time, he will be chary of accepting all the accounts given as incontrovertible. Particularly is this true of the alleged ultra-microscopic forms of the tubercle bacillus, first announced by Fontés and afterwards supported by Calmette and others. British work, as yet unpublished, appears to be in conflict with these previous findings. It is interesting that Dr. Hauduroy believes that filter-candles in the investigation of these ultra-microscopic forms should be entirely replaced by collodion membranes, the latter giving more certain and accurate results.

The three works here reviewed are noteworthy contributions to the study of epidemic diseases.

A. S. M.

The Teaching of Science.

Science Teaching: What it Was, What it Is, What it might Be. By F. W. Westaway. Pp. xxii + 442. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1929.) 10*s.* 6*d.* net.

TEACHERS do not always regard a visit from H.M. Inspectors as an unmixed blessing, but were any justification of their existence necessary, it might be found in the appearance of such a book as Mr. Westaway's on "Science Teaching"; for here we have the essence of a wide and searching, but kindly, criticism presented to us in such a way that we realise our shortcomings without feeling aggrieved that they have been discovered. The final judgement is, however, by no means unfavourable; Mr. Westaway finds much to praise, even if he is not sparing of censure where he thinks it deserved. The book is consequently one that will be read with interest and profit by the beginner, but with a full appreciation of all its niceties only by the experienced teacher.

From a book of some 440 pages, whence the irrelevant has been ruthlessly excluded, it is not possible to select more than very few of the topics for detailed consideration in a short review. Like Mr. Bernard Shaw, however, Mr. Westaway puts the gist of the matter in the preface, though fortunately not at such inordinate length. It is, for example, in the preface that we find Mr Westaway's view of the real claim of science to a place in the school curriculum, namely, its provision of new and increasing knowledge which every citizen ought to possess. Somewhat surprisingly, he refuses to admit that science can afford an insight into human motives, and denies that it provides for an analysis "of any sort of emotional experience". This is a statement that will not pass unchallenged, for in creative work science, art, and literature are closely allied, and many a man has had his sense of beauty awakened through his scientific training. Science is not necessarily unemotional, nor need art and literature be devoid of rigorous intellectual discipline.

At the same time, Mr. Westaway does well to insist that the science teacher's real battle is concerned at least as much with the dissemination of knowledge as with the training of the intellect. While it is true that the value of facts *qua* facts is comparatively small from an educational point of view, a brain well stocked with definite information is not to be despised; one remembers the "Yankee at the Court of King Arthur", who saved his life by a timely recollection of the date of the next solar eclipse. The modern world "is so full of a number of things" that a dull pupil, over whose head the tide of formal training passes undisturbed and undisturbing, may well find the greatest profit from his science teaching in the bare facts that he assimilates. The neglect to impart information is, as Mr. Westaway points out, the cardinal fault of the heuristic system, which renders progress excessively slow, even with exceptional teachers.

The judicial survey of various methods of teaching, and the suggestions for the content of the normal science course in schools, make very interesting reading. Mr. Westaway would make the periodic law the pole star of the chemistry course, and insists upon the necessity of building up chemical theory step by step, from plane to plane; only so can one avoid giving rise to such remarks as that made by a boy quoted in the book: "All the facts I have learnt in chemistry seem to be just a mixture, and not a compound." In physics, wave-motion

is assigned the most important position, ranking perhaps even before energy since it lies at the bottom of everything else—sound, heat, light, electricity, magnetism. Before any of these can be properly understood, a clear conception of wave-motion is essential. The transformations of energy should receive more attention than they get at present, and the whole of physics might be taught as just different aspects of energy.

On the question of biology in schools, Mr. Westaway offers no divided counsel. He says emphatically that it behoves all science teachers to help to educate public opinion as to the vital importance of a knowledge of biology; and he takes care to explain that by biology he does not mean "a perfunctory and amateurish study of an emasculated botany, a harmless hobby suitable for children and slow-witted girls", but a manly discipline on a level with chemistry and physics. Neglect of biology in the secondary schools accounts for the lamentable ignorance of biological principles—even of those most directly related to human welfare and right living—among the cultivated and educated classes of the country. Since the health and prosperity of the community depend very largely upon the systematic application of biological science, ignorance must quickly be replaced by knowledge if Great Britain is to retain her position in the van of civilisation.

Over the difficult problem of sixth form work, Mr. Westaway has no sympathy with the view that sixteen to eighteen years of age should be a breathing-space between the school certificate and the beginning of university work; he regards this period rather as a time when boys and girls should wrestle with serious intellectual exercises. Probably most science teachers will agree with him here, but many will nevertheless feel that the budding science specialist ought to have more time for 'leisurely thinking' and for the appreciation of poetry and art. The great danger of intensive specialisation in the last two years of school life is that the avenues to other interests may become permanently blocked; and this is, of course, true not merely of science but also of all subjects in which unfortunate higher certificate candidates are forced to specialise. A classical specialist is lucky if he gets a beggarly three periods a week at science, while his science fellow may be considered unusually well-informed if he knows more of the classics than may be gathered from "Ben Hur" at the cinema; and it would not be surprising to find that both exhibited an abysmal ignorance of art. They themselves are not to blame: they have never had the opportunity of learning. The Board of Education would do good service to future citizens if it reduced the time devoted to the study of 'special' subjects by post-school certificate boys and girls to, say, one-half of the whole; at present the fraction is nearer three-quarters, and sometimes larger still.

It is not only on such matters of grave moment that Mr. Westaway places his experience and wise counsel at our disposal. He is equally happy in suggesting improvements in detail, in directing our attention to unsuspected pitfalls, and in signalising what he has found to be good. His book will set many a young teacher on the right path, and will help many an older one to raise his performance to a much higher level of excellence; while the quiet humour and sympathetic understanding which permeate every chapter will go far to convince the harassed schoolmaster that there is, after all, something to be said for H.M. Inspectors.

E. J. HOLMYARD.

Minerals and Animal Nutrition.

Minerals in Pastures and their Relation to Animal Nutrition. By Dr. J. B. Orr, with the assistance of Helen Scherbatoff. (From the Reid Library, Rowett Research Institute, Aberdeen.) Pp. xv + 150. (London: H. K. Lewis and Co., Ltd., 1929.) 10*s*. 6*d*. net.

IN this volume Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, gives an extended, one might well say an exhaustive, review of the mineral content of pastures and its relation to the health and progress of animals grazing thereon. In addition, he describes the work which he has carried out on the subject in England, Scotland, Kenya Colony, and in other parts of the Empire. Dr. Orr sets out his conclusions as follows: Deficiencies of certain ash constituents are very widespread. Among the constituents most commonly deficient are calcium, phosphorus, potassium, sodium, chlorine, iron, and iodine.

The exclusive consumption of deficient herbage is often associated with decreased growth rate, malnutrition which may show itself in many forms, susceptibility to various diseases, development of pica or abnormal appetite which may cause animals to eat noxious materials, lowered fertility. There is some correlation between the degree of deficiency and the intensity of the symptoms produced, and between the type of deficiency and the kind of symptoms. Thus, for example, phosphorus deficiency is usually associated with pica of varying intensity according to the degree of deficiency.

There is also in general a correlation between mineral deficiencies in the herbage and the composition of the soil.

There are two methods of dealing with grass-land which produces deficient herbage. One is to manure the land with a fertiliser supplying the constituent which is deficient. The other is to give the grazing animals access to something which contains the deficient constituent. The latter method has been more widely employed because it is less expensive than to manure a whole district. In many cases it has been noticed that imported 'improved' animals are much more susceptible to deficiency symptoms than are native breeds of slower growth.

Dr. Orr's own work and all the literature on which his monograph is based support these conclusions. His book is full of valuable information and is written in a thoroughly convincing and stimulating style, which will arouse even more interest in the subject throughout the Empire than has already been created by his former reports and by his visits to several of the Dominions.

It is to be hoped that some among the many workers on pasture grass who owe their inspiration to Dr. Orr will direct their attention to an aspect of the subject as yet untouched, namely, the energy aspect. Kellner gives the starch equivalent of poor hay as 18·6 per cent, which corresponds to 200 net Calories per lb. The starch equivalent of the dry matter of young grass as determined by Dr. H. E. Woodman is in the region of 70 per cent, or 750 net Calories per lb. An average steer will not eat more than about 25 lb. dry matter per day. This amount would contain in the case of poor hay less than 5000 net Calories, and in the case of dried young grass, 18,700 net Calories. The daily maintenance requirement of an average steer is approximately 6000 net Calories. Such a steer eating his fill of poor grass or hay would therefore get barely enough net energy to maintain his live-weight, whilst from his fill of young grass he would get in addition to maintenance requirement something like 12,000 net Calories per day which he could convert into live-weight increase or any other form of production. May not this variation in the net energy value of grass be a possible explanation of some of the ills from which grazing animals suffer?

Dr. Orr quotes 270 calories per gram as the approximate caloric value of all the samples of dried grass he has examined, but from the method of calculation he has used this figure clearly represents gross calories, large and very variable proportions of which are not available in the animal's body for physiological purposes. There is a further question which I hope to investigate by the aid of samples of deficient hay kindly sent to me by Dr. Orr, namely, the method by which mineral deficiencies cause symptoms of malnutrition. Does deficiency of minerals limit appetite, or does it lower digestibility, or does it interfere with physiological utilisation?

T. B. WOOD.

The Low Veld.

The Low-Veld: its Wild Life and its People. By Lieut.-Col. J. Stevenson-Hamilton. Pp. x + 288 + 16 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1929.) 12*s.* 6*d.* net.

THE Transvaal Low Veld comprises that part of the province which lies below 2000 feet, forming a belt to its east, about 300 miles long and 70 miles broad. It has no gold, little commercial exploitation, and 8000 square miles had been established by statute as the Kruger National Park and has been left practically undisturbed for twenty-six years under the control of the author, who is almost its creator as well. It is tropical with wet and dry seasons that fluctuate greatly. Drought predominates, and in consequence fires are so common that any tree vegetation has to be drought- and fire-resistant, thus secondary and stunted, though some parts are open savannah, others dense thorn scrub, and yet others park-like with fine trees. The fires are not an unmixed disaster, for they destroy disease-carrying ticks and doubtless many other noxious pests, while they are followed by a richly nutritive vegetation. At the same time the loss of exposed soil in the heavy rains gradually adds to the desiccation.

Here, in the Park, wild Nature reigns, and probably the white rhinoceros is the only mammal out of 128 enumerated that has become extinct through the activities of white hunters. The tameness of antelopes, zebras, elephants, and many others, is strikingly depicted, and the book bristles with observations of value, such as the fact that lions in their cannibalism show a sexual consideration in that a male or female will not generally consume its species of the opposite sex. The gross increase of the larger antelopes is estimated at 30 per cent annually, net 15 per cent, and were lions not checked, 5 per cent. Deaths from old age occur after fifteen years, and other causes contributing to decrease are combats between males, calving, sickness, and snake-bite. In 1896 came the rinderpest and the buffalo herds were reduced to about

dozen individuals. Attention is directed to the fact that after its passing the tsetse fly, wherever rinderpest came, was found to have disappeared not only here but also all over Africa, an observation worthy of the close attention of every biologist.

Chapters on the vegetation, birds, reptiles, and fishes are equally illuminating, and the author, like all old inhabitants of native lands, loves to describe the medicinal and other uses of his fruits and trees. The crocodile is a real danger to drinking mammals, but it is kept in check by the egg-eating water monitor, which grows to 7 feet in length. The lizards, most pugnacious little warriors, would assuredly repay study, but the mambas, cobras, and puff adders sound unpleasant, especially the first, as it attacks whoever is in its route. The losses sustained by agriculture from insects are estimated " to exceed that from all other causes—drought, hail, disease, birds, and mammals—put together ". There are also hippo- and bot-flies and *Anopheles* to carry malaria, balanced by attractive stick and praying insects, and white ants, of which we cannot know too much. Locusts come occasionally, but it is questionable whether most insect migrations are correlated with winds. Lastly, there was the author's baboon, which specialised on scorpions, patiently turning over stones, then getting almost hysterical until her hand darted in, pulled off the terminal poison claw, and crammed the body into her mouth.

This most interesting book concludes with chapters on the recent history of the country and on its natives and their customs. J. S. G.

Our Bookshelf.

Cements, Limes and Plasters: their Materials, Manufacture, and Properties. By Edwin C. Eckel. Third edition; with Chapters on Alumina Cements and High-Strength Portlands. Pp. xxxiv + 699. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 35*s*. net.

THIS new edition of a standard American book contains an additional section of forty pages devoted to the alumina cements (*ciment fondu*) and the accelerated or high-early-strength Portland cements. Otherwise the book remains unaltered.

In the new section, the different processes of manufacturing the new high-speed cements are clearly and accurately described, and a good account is given of their remarkable physical and chemical properties. A useful list of references to the literature upon the subject is appended to each chapter. The superior resistance of *ciment fondu* to sea-water and to alkaline and sulphate-bearing waters is described, but nothing is said about its behaviour with other solutions. It is perhaps too early to give anything like a general account of the chemical behaviour of this material. The chemical engineer will be well advised to carry out exhaustive tests under plant conditions before using it for the construction of containers for his solutions. The author thinks that " the engineer will in the near future choose his cement from among three groups: (1) Alumina Cements, made in blast furnaces at or below the present Portland costs, and giving extreme high early strengths and high chemical resistance; (2) High-Strength Portlands, still made perhaps in the rotary kiln but with even higher lime and silica than now current; and (3) some type of Portland-Silica or Portland-puzzolan mixture, giving better chemical resistance than straight Portlands."

It is in every way an excellent book describing thoroughly and clearly, albeit from the American point of view, the manufacture of gypsum plasters, limes, magnesia and oxychloride cements, hydraulic limes, natural cements, Portland cement, puzzolan cements, alumina cements, and high-strength Portlands.

The author describes fully and clearly the design and arrangement of the different kinds of plant and discusses the power requirements, heat consumption, and operating costs of the various processes. In view of the rapid fluctuation in the price and manufacturing costs of cements since the War, the author wisely retains the pre-War costs data for purposes of accurate comparison. The book can be recommended to the chemical engineering student as a valuable text-book. It is a mine of reliable information to all who are interested in the particular manufactures with which it is concerned.

Photochemische Versuchstechnik. Von Prof. Dr. J. Plotnikow. Zweite, erweiterte, auf photomechanischem Wege hergestellte Auflage. Pp. xvi + 454 + 3 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) n.p.

THE first edition of Plotnikow's book was published in 1911, and the present edition, for the most part, is simply a reproduction made by photomechanical methods. Those who are acquainted with the first edition know that its main characteristics consist in the description of apparatus devised and of methods used by Plotnikow, comparatively little attention being paid to the work of other investigators. Much the same course is pursued in the following additions incorporated in the present volume. Pages 93-106 consist of descriptions of new ' light thermostats ' and apparatus for exposure to light on a large scale devised by the author. Pages 202-226 describe methods for the measurement: (*a*) of the energy of radiation, (*b*) of absorption coefficients, (*c*) of light intensities by the tube photometer, (*d*) of the Schwarzschild constant. In connexion with the latter constant it is mainly Plotnikow's own methods to which reference is made, and no mention occurs of the accurate methods which have been used, for example, in very extended investigations in the Kodak laboratories. Pages 254-268 contain additions to the various lecture experiments described in the first

edition, and pages 416-438 contain new tables of the absorption coefficients of solutions of various substances. There are very few additions to the literature references given in the re-printed part of the book, and the references to the new parts are very far from complete. Apparently no corrections have been made in the older parts; for example, it is still stated that the action of light on silver chloride gives rise to sub-chloride.

In the preface the author states that complete revision of the subject matter is left to the next edition. It is to be regretted that such a revision was not carried out for the present volume. When such an edition is published, it is to be hoped that only the apparatus and methods of Plotnikow which have stood the test of experiment will be described, and that the work of other investigators will also be incorporated in its due proportion.

The Tropical Crops: a Popular Treatment of the Practice of Agriculture in Tropical Regions, with discussion of Cropping Systems and Methods of growing the leading Products. By Otis Warren Barrett. (The Rural Science Series.) Pp. xviii +445+24 plates. (New York: The Macmillan Co., 1928.) 17*s.* net.

THE author estimates that about one-half of the area of cultivable land in the world lies within the torrid zone. When one considers the wide range of rainfall, humidity, temperature, peoples and civilisations which exist in the tropics, one realises that the agriculture of this part of the world embraces a very much wider field than can possibly occur in the temperate zones, where the range of such conditions is much more limited.

As this book is based mainly on the personal observations of the author, it is evident that only those aspects of tropical agriculture with which he is familiar can be dealt with at all fully. The book is chiefly confined to the perennial crops of the tropics and to those grown in more humid climates. So far as these are concerned the book is of value, especially since the writer has had so long an experience of such crops and conditions.

More than a quarter of the book deals with tropical fruits, many of which are of purely local interest. Reference is made to many tropical plants which yield commercial products but are only remotely connected with agriculture. On the other hand, the arable crops of the tropics are very briefly dealt with, and this aspect of tropical agriculture is evidently outside the writer's experience. He makes the statement that "really proper tilth in tropical areas is rare". This entirely neglects the arable agriculture of the Old World tropical civilisations, such as is to be seen in India, China, and Egypt, where very high standards of arable farming exist. Crops such as tropical cereals, bast fibres, oil-seeds and pulses, all of which are vital to the needs of the dryer regions of the tropics, are dismissed in a few pages. Even rice, which the author refers to as the world's most important crop, is summarily dealt with in less than three pages.

H. C. S.

Automaton: or the Future of the Mechanical Man. By H. Stafford Hatfield. (To-day and To-morrow Series.) Pp. 100. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s.* 6*d.* net.

THE idea of a 'mechanical man' has receded into the background since the advent of the mechanical age. When practically all our necessities are provided by automatic or semi-automatic machines there is no necessity to construct things having the external appearance of men and doing our bidding. They would do it much more effectively if they were specially designed for the job. Yet it is interesting to follow the author's account of modern efforts towards complete automatism, from the sorting of letters to the self-steering aeroplane. He recognises that mechanisation has worked both ways, and that, while machines have been endowed with almost human faculties, man himself has become mechanised, inasmuch as civilisation and humanitarianism tend to "create communities of well-washed, well-fed, well-regulated, well-behaved, mildly cultured people as devoid of all individuality as machine-made automata". An eminently readable essay.

The Elasmobranch Fishes. By Prof. J. Frank Daniel. Pp. xi + 332 + 30 plates. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1928.) 27*s.* 6*d.* net.

STUDENTS and teachers of zoology alike will welcome the second edition of Prof. Daniel's comprehensive treatise on the elasmobranch fishes. The same method of treatment as that adopted in the first edition has again been followed. In dealing with the various systems of organs, a detailed description of the condition found in the notidanid shark *Heptanchus maculatus* is given, followed in each chapter by a comparative account of the more specialised forms. In this way the reader is made familiar not only with the general structure of the group but also with the various modifications and specialisations exhibited by different members of it. A considerable amount of new subject matter, several additional illustrations, and a number of corrections of the original text serve greatly to enhance the value of this useful and attractively produced work.

Flora of the Presidency of Madras. By J. S. Gamble. (Published under the Authority of the Secretary of State for India in Council.) Part 8: *Ulmaceæ to Xyridaceæ.* By C. E. C. Fischer. Pp. ii + 1347-1532. (London: Adlard and Son, Ltd., 1928.) 10*s.* net.

SINCE, on the death of Mr. J. S. Gamble, the "Flora of the Madras Presidency" was left unfinished, the continuation has been undertaken (at the express wish of Mr. Gamble) by Mr. C. E. C. Fischer, late of the Indian Forest Service and now assistant for India at Kew. The present part comprises the concluding families of the Angiosperms (Ulmaceæ to Salicaceæ), Gymnosperms, and the Monocotyledons from Hydrocharitaceæ to Xyridaceæ.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Glasses Transparent to Ultra-violet Radiation.

DURING the past few months an investigation has been carried out in this laboratory upon the transparency of various ultra-violet transmitting glasses under different conditions. In view of the conflicting statements that have been made concerning the behaviour of these glasses, the results are of considerable interest.

The apparatus used for determining the percentage transmission for radiation of different wave-lengths is set up as follows: A quartz mercury vapour lamp is the source of energy. Radiation from the lamp passes through either the piece of glass under test, or, alternatively, through an adjustable rotating sector. It then traverses two monochromators in series. These instruments select any particular wave-length which is required, and allow this radiation to fall upon a sodium photoelectric cell. The essential part of the determination consists in adjusting the rotating sector until an identical photoelectric current is obtained, when the glass is substituted for the sector, and vice versa. This apparatus is found to give accurate results. Transmission values are determined for several mercury lines, and curves drawn for each glass.

It is a well-known fact that glasses transmitting ultra-violet radiation undergo a change when exposed to such radiation, and become rather less transparent. The speed and magnitude of this change vary among different glasses, and even to a small degree among individual pieces of glass of the same general composition. The change is known as 'solarisation'. It is brought about very much more rapidly by exposure to a quartz mercury vapour lamp than to sunshine, the glass attaining a state, hitherto regarded as stable, after a period of a few hours instead of several days or weeks. These facts have led to the almost universal use of the mercury vapour lamp by investigators of these phenomena.

After solarising a number of specimens by means of the mercury vapour lamp, it was observed that they had taken on a brownish tint. These pieces of glass were placed upon a laboratory table under a window, at ordinary room temperature, and after some days it was noticed that the brownish tint was less pronounced. Upon re-examining these test pieces it was found that they had regained some of their lost transparency. Further investigations revealed the following facts:

(1) When kept in the dark, glasses solarised by the quartz mercury lamp do not regain any of their lost transparency.

(2) Glasses thus solarised, when exposed to sunlight, regain some of their lost transparency.

(3) Glasses thus solarised, when covered with ordinary window glass and exposed to sunlight, regain some of their lost transparency.

(4) Glasses thus solarised, when covered by a thick layer of ordinary window glass, and further exposed to the mercury vapour lamp, regain a similar amount of their transparency quite rapidly, the change being more rapid with a thick covering of ordinary glass than with a thin.

The following figures will show the extent of these changes for different types of glasses. The figures are percentage transmissions for radiation of wave-length 3000 A. for a thickness of glass of 2 mm. Transmissions for 3100 A., perhaps the most important physiologically, owing to its much greater intensity in solar radiation, are of course very considerably higher in each case.

All investigations have been carried out at ordinary room, or outside, temperatures, except in so far as the mercury lamp causes a slight warming of the specimens—an amount which we have found to be quite insufficient to have any effect upon transmission values.

Original Transmission (per cent).	After Complete Solarisation by Quartz Mercury Lamp (per cent).	After Subsequent Exposure of Solarised Glass to Sunlight (per cent).
59	35	47 (5 days' exposure)
59	32½	45 (5 ,,)
60	32½	45 (9 ,,)
59	31½	48 (9 ,,)
35½	25	31 (9 ,,)
35½	25	31½ (3 ,,)
		After Subsequent Exposure to Sunlight under Ordinary Window Glass.
57½	32½	44 (5 days' exposure)
		Further Exposed to Lamp shielded by Ordinary Window Glass.
75½	52½	58½ (8 hours' exposure)
66	35	46 ,,
66	38	47 ,,

Two pieces from the same sheet of ultra-violet glass were now taken. One of them was solarised completely by the quartz mercury lamp. Both were exposed during very fine weather to ordinary sunlight on the top of a building. The original untreated piece of glass, the transmission of which was 58½ per cent, was tested every day, and was found to have attained an almost steady state (46 per cent) in six days, of which two days had been dull, producing no change. After these six days the change in the glass was very slight indeed, the final transmission figure, after several weeks, being 45 per cent. The artificially solarised sample, the transmission of which was 33 per cent at the commencement of this experiment, was found to have improved in transmission during six days up to 43½ per cent. After 24 days the transmission was 45 per cent, and after 32 days it was still 45 per cent.

In view of these results we decided to send some specimens on a ship to Madeira and back. These specimens experienced very brilliant weather. Glasses of two different compositions were taken, and two specimens of each, one being new glass and the other glass completely solarised by the mercury lamp. Glasses widely different in transparency were chosen. The following are the figures for the transmission of these four specimens, before and after the voyage:

NEW GLASSES.			ARTIFICIALLY SOLARISED GLASSES.		
	Original (per cent).	At End of Voyage (per cent).		At Beginning of Voyage (per cent).	At End of Voyage (per cent).
A.	56	43	*A.*	29½	43
B.	34½	29½	*B.*	24	29½

It is significant that the two specimens of glass *A*, one untreated and the other artificially solarised, have

finished the voyage with identical transmissions, the falling off of one being of the same magnitude as the recovery of the other. The same is true of glass *B*, which is of very much lower transparency, and of entirely different composition.

We consider that these figures prove conclusively how completely misleading has been the use of the mercury vapour lamp by investigators to determine the loss in transparency of glasses when exposed to natural sunlight.

A. R. WOOD.
M. N. LEATHWOOD.

Research Laboratory,
Crown Glass Works,
St. Helens, Aug. 27.

Turbulence in the Sun's Atmosphere.

IT is well known that the density gradient in the solar chromosphere is vastly less than what it would be in ordinary gravitational equilibrium. This was a complete enigma until the advent of Milne's theory of selective radiation pressure in the case of ionised calcium. This theory has had many successes but does not seem to admit of generalisation to gases like hydrogen and helium which are present in abundance. It even seems that the radiation pressure is important for Ca^+ only if enough hydrogen is there initially to prevent excessive ionisation (McCrea, *Mon. Not. R.A.S.*, **89**, p. 843; 1929; NATURE, April 6, 1929, p. 527). We have still to explain the presence of these gases.

The failure to do so hitherto seems to illustrate a recent remark of Rosseland's that the use of more general hydromechanics is demanded in astrophysical applications (*Mon. Not. R.A.S.*, **89**, p. 49; 1928). In particular, he shows that if there is *any* relative motion of the gases in the sun, it must be *turbulent* motion. The reality of such turbulence is demonstrated by the 'granulations' of the solar surface and by the scattering of prominence material.

Unsöld has lately measured the contours of the chromospheric *H*, *K* lines of Ca^+ in emission and absorption and finds them determined by a Doppler effect (*Astrophys. Jour.*, **69**, p. 207; 1929). He, too, independently concludes that this is only to be accounted for by turbulence. He supposes the turbulent velocities (*U*, *V*, *W*, say) have a Maxwellian distribution and so derives scattering coefficients varying as $e^{-\left(\frac{\Delta\nu}{\Delta\nu_0}\right)^2}$, where $\Delta\nu$ is the distance from the line centre. He finds $\Delta\nu_0$ to correspond to 15 km./sec., which is large compared with the temperature motion. Neglecting the latter, the velocities in the line of sight must be distributed like $e^{-U^2/2\overline{U^2}}$, where $\overline{U^2}$ is the mean of U^2 and clearly $2\overline{U^2}$ corresponds to $\Delta\nu_0{}^2$. Hence the mean resultant velocity $C = \sqrt{\overline{U^2} + \overline{V^2} + \overline{W^2}} = \sqrt{3\overline{U^2}}$ is $15\sqrt{\frac{3}{2}} = 18{\cdot}4$ km./sec. Supposing this to be true turbulence, it must be the same for all gases present.

For hydrogen at 5000°, the probable temperature *T* of the chromosphere, the mean resultant velocity *c* due to temperature alone is 11·1 km./sec. which is no longer small compared with *C*. The mean resultant square velocity C^* of the hydrogen atoms is found to be given by $C^{*2} = C^2 + c^2$, so that $C^* = 21{\cdot}5$ km./sec.

The question then arises as to the effect on the gas pressure. But the dynamical pressure in a gas is merely $p = \frac{2}{3}$ (mean kinetic energy) × (number of atoms per cm.^{3}) and, averaged over a sufficient area, is the same whether the kinetic energy is due to temperature or turbulence motion. Hence in calculating *p*, C^* and not *c* must be used. The result can be expressed simply by saying that *p* is given by an 'apparent temperature T' where $T = (C^*/c)^2 T$. We find T = 18,800°. The density gradient must therefore also imitate that at temperature T, so that $\rho \propto \exp\left(-\frac{Hgy}{kT}\right)$ instead of $\exp\left(-\frac{Hgy}{kT}\right)$, where *H* is the atomic mass, *k* the gas constant, *g* gravity, and *y* height in the atmosphere. Hence $\rho \propto \exp\left(-1230\frac{y}{a}\right)$ and not $\exp\left(-4600\frac{y}{a}\right)$.

Now Pannekoek and Minnaert (*Verh. d. k. Akad. Amsterdam*, **13**, No. 5; 1928) have obtained from observation the empirical law for hydrogen $\rho \propto \exp\left(-1127\frac{y}{a}\right)$. The agreement of the new theoretical value is therefore very satisfactory. The fact that the *observed* value of the turbulence leads so immediately to this result seems scarcely to leave room for any other explanation.

We have neglected ionisation. In *Mon. Not. R.A.S.* (loc. cit.) I have estimated that hydrogen at the base of the chromosphere is only about 2 per cent ionised. This would be invalidated if the well-known anomalous behaviour of the ratio of excited to normal hydrogen atoms should affect the chromosphere. The extension of the above ideas to an ionised gas is not easy, because the electrons have already such a high velocity that turbulence scarcely increases it and so T for the electrons, T_e say, is still 5000°, while for the ions, T_i say, it is the 18,800° found before. It can be shown, however, that for a *highly* ionised gas the density gradient will be that for a neutral gas at temperature $(T_i + T_e)$ instead of the usual result (Fowler, "Statistical Mechanics" (1929), p. 359) for such a gas, namely, 2*T*. The *neutral* atoms will in these cases have density gradients as at temperatures $\frac{1}{2}(T_i + T_e)$ and *T* respectively. We find, therefore, that the turbulence would mean a law $\exp\left(-1940\frac{y}{a}\right)$ instead of $\exp\left(-4600\frac{y}{a}\right)$ for these atoms. The agreement would not then be so good as before. But, since even in this most unfavourable case the turbulence, if real, must *necessarily* produce such a large part of the decrease in the density gradient, one can scarcely help concluding that in the actual case it must account for the whole of it. No other known agency gives anything but the law $\exp\left(-\frac{Hgy}{kT}\right)$ for the *neutral* atoms.

For all other elements, turbulence would give a density gradient only a little steeper than for hydrogen. So it would account for the presence of other gases in the chromosphere without appeal to atomic peculiarities, even lightness. Of course, ionisation may bring in minor complications; or, where selective radiation pressure is important, we may have still smaller gradients.

I have obtained a certain amount of success with a somewhat similar theory of the corona.

It would appear that the turbulence does not appreciably degenerate into heat in the chromosphere, but it must do so somewhere. Hence it must somewhere affect thermodynamic conditions. An attempt to picture the *modus operandi* of this degeneration seems to show that it will mean that at any instant a fraction of the atoms of the gas will have properties characteristic of a higher temperature than the gas as a whole. For one thing, the collisions between atoms belonging to portions of gas with different turbulent velocities would, in our case of hydrogen, be like those in a gas at real temperature T, although even if all the turbulence were transformed to heat it could not give a temperature so high as T because of the loss of kinetic energy transformed to internal energy (excita-

tion, etc.). The resulting deviation from thermodynamic equilibrium would be qualitatively of the kind observed in stellar atmospheres (Adams and Russell, *Astrophys. Jour.*, **68**, p. 9 ; 1928). It promises to be the true explanation, but first demands refinements of the theory of the turbulence.

A further account of this work is to appear in *Mon. Not. R.A.S.* Supp. Number 1929.

W. H. McCREA.

Göttingen, Aug. 23.

A Habit of the Common Periwinkle (*Littorina littorea* Linn.).

AN interesting habit of the common periwinkle, *Littorina littorea* Linnæus, which does not appear to have been recorded by previous writers, is worthy of some attention. On boulder-strewn shores, such as that at Penrhyn Bay, North Wales, where these observations were made, this species may occur in enormous numbers at and below the half-tide level in situations devoid of the larger Fucoid algæ. The boulders are covered with barnacles and afford no shelter from the sun except on the north side or in shady crevices. The periwinkles, nevertheless, cling

FIG. 1.—Photograph of *Littorina littorea* Linn. attached by dried mucus films to a boulder at low tide.

in closely packed rows to the sides of the boulders, especially near the base where it is damp, but also higher up, and they may become completely dried on a hot day.

Other writers have observed that these resting periwinkles are almost always orientated with the apex of the shell downwards, in which position the head and the lip of the shell are uppermost. But it does not seem to have been generally realised that if the day be dry the molluscs do not cling to the rock with the foot, but stick their shells to it and then completely retract the body, shutting themselves in with the operculum. In this condition they are in no danger of desiccation while awaiting the return of the tide.

The attachment is effected as follows. As the receding tide exposes the snails and they begin to dry in the sun, they secrete a little mucus in such a way that it forms a sticky film between the outer arc of the shell's lip and the rock surface. This film soon dries, becoming hard and brittle, but of sufficient strength to support the weight of the mollusc on a steeply sloping or even vertical surface. The animal then releases its foothold and completely retracts. The brittle film can support little more than the periwinkle's own weight, and that only in the position in which they are usually orientated, namely, with the lip uppermost. It sometimes happens that an individual orientates itself with the lip of the shell downwards, and then almost invariably the creature topples over as soon as it trusts to the film for support.

The accompanying photograph (Fig. 1) shows several rows of periwinkles stuck by their mucus films to the almost vertical side of a boulder. The close ranks of the molluscs are characteristic for the shore mentioned above. It will be noticed that all are orientated with the lip uppermost, with the exception of two individuals, one in the bottom left-hand corner and one near the right edge of the photograph. Apparently these had attempted to fasten themselves lip downwards but had toppled over on retraction. At the time, however, the mucus was probably still pliable, and they now rest with their lips still stuck to the rock but their weights partly supported by snails immediately below. Other specimens have occasionally been seen in similar positions. The dried and brittle mucus film is often so fragile that on a gusty day it is a common sight to see odd specimens blown off, and the sound of dropping periwinkles is heard at intervals.

Since these observations were made, it has been noticed that the periwinkles in the Plymouth Aquarium tanks frequently crawl up the glass or slate sides until they are well above the surface of the water, and if the air in the laboratory be at all dry they will stick themselves in position in the way they do on the shore and will pass several hours in a state of complete retraction. D. P. WILSON.

Marine Biological Laboratory,
Plymouth, Aug. 8.

The Nitrogen Afterglow.

DURING the past year a further study has been made of the decay of the nitrogen afterglow and the phenomena connected with the production both of this luminosity and the accompanying chemical activity ; while the minutiæ of the quantitative parts of the investigation remain to be examined more closely than at present, certain very definite findings may briefly be given.

(1) The decay of the afterglow is without doubt only partly a homogeneous reaction in glass vessels which have been most scrupulously cleaned.

(2) The amount of divergence from the homogeneous reaction is determined, for any given vessel, by the purity of the nitrogen employed. In agreement with Bonhoeffer and Kaminsky, the writer finds that the influence of the traces of electronegative gas essential to the production of a glow is confined almost certainly to the surfaces and that the effective concentration of these 'photogens', as they may conveniently be termed, lies between definite limits which vary slightly from gas to gas ; within these limits the surface reaction is held down to a minimum and the gas phase decay is then of the second order with respect to the glow-producing system, and very probably of the third when the influence of the neutral nitrogen is allowed for.

(3) Unless the purity of the nitrogen is carefully controlled, the apparent 'order' of the decay can vary widely ; this is the most probable explanation of the discrepancy between the experiments of Kneser (*Ann. Physik*, **87**, 717 ; 1928) and earlier investigations (*J. Chem. Soc.*, 1620; 1928: 228; 1929) made by the writer.

(4) Under conditions where wall decay has been minimised and the gaseous process predominates, no appreciable change in the order of the reaction takes place with time and no apparent alteration occurs in the afterglow spectrum so far as λ4000 A.

(5) In glowless nitrogen the chemical activity is either absent or scarcely detectable; addition of photogenic gases causes, however, a development of chemical activity which generally increases less rapidly than the corresponding rise in luminosity. No simple relationship apparently exists between glow intensity and concentration of chemically active nitrogen, except possibly under certain conditions which are determined by the state of the walls; in this case there is direct proportionality.

(6) Addition of small amounts of oxygen or nitric oxide to a stream of glowing nitrogen causes a large development of radiations which lie in the blue and regions of shorter wave-lengths. (This has also been observed by Mr. G. C. Eltenton, using the writer's former apparatus at Cambridge.)

(7) The intensity of the green flame produced when 5 per cent or so of nitric oxide is fed into a stream of glowing nitrogen appears to follow the same intensity relations towards the concentration of chemically active nitrogen as does the luminosity of the nitrogen alone under the same conditions.

(8) The decay rate of a stream of luminous nitrogen can be varied by addition of photogens without affecting the amount of the chemically active species present. This suggests that two bodies of different types are concerned in the production of the glow, one being very susceptible to surface conditions and the other (which may be the chemically active form) much less so.

The existence of these strong wall effects would seem, assuming the analogy with active hydrogen to hold, to be very strong evidence in favour of the hypothesis that atoms are concerned in both the luminous and chemical phenomena associated with active nitrogen, and recent work by Compton and Boyce (*Phys. Rev.*, 1929) and Kaplan (*Phys. Rev.*, 1929) shows that two species of metastable atom (2·3 volts and 3·6 volts) and a metastable molecule (8·5 volts) are present.

Spectroscopic evidence is thus provided for a body of an energy content which agrees very closely with the energy of active nitrogen as found by Dr. E. K. Rideal and the writer, in agreement with Lord Rayleigh, the value of 2·0-2·2 volts (46,000-50,000 cal./gm. mol.) having been obtained from experiments upon the chemical reactions of this mysterious substance. But even if this does bring into harmony the physics and chemistry of active nitrogen, an explanation has still to be found as to why the other excited species present are apparently chemically inert and why also only about one-sixth of the total energy available is apparently effective.

If it could be proved that the chemical activity is due to these 2·3 volt metastable atoms and their precise nature established, it would clearly be of great value in leading towards an understanding of the nature of chemical reaction.

E. J. B. WILLEY.

University College, London,
July 24.

Natural Selection.

IN a communication in NATURE of Aug. 10, Prof. E. W. MacBride, while admitting the reality of natural selection, denies that it applies to random variation. He dismisses ill-adapted 'types found in Nature as "pathological", and states that selection favours "the most vigorous individuals". It is not clear to me that much is gained by substituting the words 'vigorous' and 'pathological' for Darwin's 'fit' and 'unfit'.

Little valuable result is likely to arise from a discussion of the subject which ignores the large amount of quantitative work that has been done in recent years on natural selection. Unfortunately, most of this work is published in Russian periodicals, which are not easily available in England. However, the readily available work of Sukatschew (*Zeit. Ind. Abst. u. Vererb.*, **47**, p. 54) illustrates the nature of the 'fitness' or 'vigour' which distinguishes varieties. Two races of dandelion, *B* and *C*, from the same lawn were grown at the same density in pure and mixed cultures. After two years, 49 per cent of *B* and 24 per cent of *C* survived in the pure cultures, 20 per cent of *B* and 58 per cent of *C* in the mixed cultures. The numbers of flowers per plant varied in the same direction. Clearly, vigour in this case is simply fitness in a given environment, and is mainly determined by physiological causes. No one could have predicted the above results from an examination of the morphology of the varieties.

Detlefsen and Roberts (*Genetics*, **3**, p. 573) in mice, and Pearl and his colleagues (*Am. Nat.*, **55-58**) in *Drosophila melanogaster*, have shown that Mendelian genes may determine differences in 'vigour', that is, in viability under the conditions of culture observed. Not all genes cause measurable differences. Thus only one out of the three tested in mice caused any appreciable difference in mortality during the first three weeks of life. The reason why black mice in captivity are about 2 per cent less viable than grey is not known, but has clearly nothing to do with protection from predatory enemies. Nevertheless, it is a fact, and one which should surely not be ignored in discussing why most wild mice are grey. When, in addition, it has been shown that local races of *Drosophila* and rodents, and also rodent species, differ by Mendelian colour genes, it is clear that such a discussion is relevant to the problem of evolution.

It seems likely that, as Prof. Watson suggests in his presidential address to Section D of the British Association (see "Adaptation", p. 231 in NATURE of Aug. 10), physiological differences between varieties, such as exist between *B* and *C* dandelions, or grey and black mice, may prove to be of greater selective value than the morphological differences which immediately strike the eye of the taxonomist or geneticist. But if the value to a species of such morphological differences has often been exaggerated, quantitative work shows clearly that natural selection is a reality, and that, among other things, it selects Mendelian genes, which are known to be distributed at random through wild populations, and to follow the laws of chance in their distribution to offspring. In other words, they are an agency producing variation of the kind which Darwin postulated as the raw material on which selection acts.

J. B. S. HALDANE.

Rate of Dissociation of Nitrogen Tetroxide.

THE speed at which the reaction $N_2O_4 \rightleftharpoons 2NO_2$ attains equilibrium has been a subject of investigation for the last half-century. Since ordinary methods are valueless, attempts have been made to determine this rate by using the velocity of sound in the dissociating gas.

Einstein (*Sitzungsber. d. Berl. Akad.*, 1920) has developed equations for the change of velocity of sound with frequency. At low frequencies the reaction is always in equilibrium as regards pressure changes due to the sound waves, while at high

frequencies the alternations of pressure are so rapid that the equilibrium cannot follow them. Therefore, in a gas such as nitrogen tetroxide, where increasing pressure promotes association, there will be a greater increase in density in the compressions and a greater decrease in the rarefactions at low frequencies than at high frequencies. Consequently there will be two values of the velocity of sound, the higher, u_∞, at high frequencies, corresponding to frozen equilibrium, and the lower, u_0, at low frequencies, corresponding to complete equilibrium. At some region of intermediate frequencies, the 'critical' region, where the time for the attainment of equilibrium and the time for one vibration are of the same order of magnitude, there will be a varying velocity of sound corresponding to partial equilibrium. For the critical region an approximation formula holds from which the velocity constant may be computed, and for the other two cases values of u_0 and u_∞ may be calculated corresponding to experimental temperatures and pressures.

Grüneisen and Goens (*Ann. Phys.*, **72**, 193; 1923), using a resonance method and audible sound up to 15,600 vibrations a second, found values of the velocity of sound always corresponding to u_0; for example, 187 m./sec. at 25° and 565 mm. (calculated value of u_0, 189 m./sec.).

In September 1927 we began a re-investigation of this problem, using ultrasonic vibrations produced by a quartz crystal as described by Pierce (*Proc. Am. Acad. Art. Sci.*, **60**, 271; 1925), Loomis and Hubbard (*J. Optical Soc. Amer.*, **17**, 295; 1928), and others. We found that contamination by air was a prolific source of error. For our purest sample (0·1 per cent air) we obtained a velocity of 192·6 m./sec. at 25° and 565 mm. pressure at a frequency of 51,570 vibrations a second, corresponding to a value of 5630 for the velocity constant. This result will be confirmed as soon as possible.

A. R. OLSON.
C. E. TEETER, JR.

Department of Chemistry,
University of California,
Berkeley, California,
Aug. 8.

A Function of the Adrenal Cortex.

SINCE the appearance of our communication in NATURE on a function of the adrenal cortex (Dec. 29, 1928, p. 998), a paper on the same subject has appeared in the *Journal of Physiology* (vol. 67, p. 343; 1929) by H. Florey, A. Szent-Györgyi, and M. E. Florey, in which they offer a 'criticism' of the statement that decerebrated adrenalectomised cats die in a short time from respiratory failure. These three investigators base their contradictions on two experiments, whereas our conclusions were drawn from more than one hundred experiments. The longer the interval that elapses after decerebration and before adrenalectomy the quicker the respiratory failure. But, in one of the experiments performed by these workers, adrenalectomy was performed *before* decerebration and therefore, so far as a repetition of our work is concerned, must be discounted altogether.

Naturally, there have been one or two exceptions in our own series due, probably, to accessory cortical bodies. The above-mentioned workers state that "post-mortem examination did not disclose any accessory adrenal bodies". We should like to know whether serial sections were cut of the whole reproductive organs. These bodies can rarely be found in the cat by ordinary methods of dissection. Again, they suggest that any other extracts increase respiration. This, of course, is possible, but they seem entirely to miss the main point that pneumin restores respiration after it has failed from adrenalectomy—an experiment they have not performed, since the condition did not occur in their one experiment.

Apart altogether from theoretical considerations, there can be no doubt that if a cat be decerebrated and then, after a lapse of one or two hours, the adrenal bodies be removed, symptoms of respiratory failure will not be long in appearing and the animal will be dead in an hour or so. A contradiction, based upon one experiment, of results obtained from a prolonged series of investigations, can scarcely be considered as obeying the elementary rules of scientific investigation.

SWALE VINCENT.
J. H. THOMPSON.

Dept. of Physiology,
Middlesex Hospital Medical School.

A Crystalline Tripeptid from Living Cells.

IT has recently proved possible to isolate from cell extracts, for example, from extracts of yeast and red blood corpuscles, a tripeptid containing glycine, glutamic acid, and cysteine, which readily crystallises. The separation is based upon the insolubility of the cuprous salt of the substance in normal sulphuric acid. This property of the salt makes cuprous copper an exceptionally selective precipitant.

The tripeptid is obtained in amounts which suggest that it is a cell constituent of importance. As a cysteine peptid the ease with which it crystallises is exceptional, and the unexpected instability which it displays in various circumstances makes it an interesting substance from the point of view of general protein chemistry.

The isolation of this pure substance has indicated that 'glutathione', as previously described by myself, is not an individualised substance. Preparations as described have contained a large proportion of the tripeptid. As a number of workers are employing such preparations in experimental work, it seems desirable that I should make the error known as soon as possible. A description of the tripeptia is in the press and will shortly appear in the *Journal of Biological Chemistry*.

F. GOWLAND HOPKINS.

Zoological Nomenclature.

IN accordance with the provisions of the International Rules of Zoological Nomenclature, the attention of the zoological profession is hereby invited to the fact that the secretary of the International Commission on Zoological Nomenclature is recommending to the Commission the nomenclatorial suppression of P. F. Gmelin's, 1758–1777, "Onomatologia Historia Naturalis Completa (Onomatologia Medica Completa)", volumes 1-7. This recommendation is based on the premise that the adoption of this nomenclator under the Rules will produce greater confusion than uniformity. Final vote in Commission will be taken about Sept. 1, 1930, and zoologists interested in this case are cordially invited to present to the Commission their views, *pro* or *con*, not later than that date.

C. W. STILES
(Secretary to Commission).

U.S. Public Health Service,
Washington, D.C.

The Enclosure of the Zuider Zee.

By Dr. BRYSSON CUNNINGHAM.

THE remarkable series of operations now in progress at the Zuider Zee scarcely seem to have received in England the attention which so extensive and fundamental an interference with the natural littoral and fluvial regimen of northern Holland might reasonably be expected to arouse. They are, indeed, of an epoch-making character, and the effect on the map will be striking and drastic. The coastal contour will be completely altered, entirely new drainage systems will come into existence, and vast areas of submerged land will be brought under cultivation. Although the works cannot be completed in their entirety for a number of years to come, some account of their inception and present position will be of interest. The moment, moreover, is appropriate, since the first section of submerged land, 50,000 acres in extent, scheduled to be reclaimed, has just been completely enclosed. The map reproduced as Fig. 1 shows the region of operations, with the reclamation areas indicated by broken lines.

FIG. 1.

The coast of Holland is fringed by ridges of sand dunes which towards the north have been intersected by incursions of the sea, forming a series of islands between which and the mainland lies a kind of roadstead, or outer basin, called the Wadden Zee, and farther south, an extensive inland basin, the Zuider Zee, which probably acquired its present shape some time before the fourteenth century. There is a pronounced difference between the two basins. The floor of the Wadden Zee is full of irregularities. It consists largely of steeply rising sandbanks, many of which are exposed at low water, and are separated by more or less deep channels which become deeper as they approach the North Sea. The most important of these straits is that which finds an outlet between the island of Texel and the mainland, where it is from 100 ft. to 160 ft. in depth. Between the adjacent islands of Vlieland and Terschelling, a similar passage has depths varying between 60 ft. and 100 ft. The tidal range, though small compared with British standards, is appreciable, being as much as 5 ft. at Den Helder and 5½ ft. in the Vliestroom, and the currents are correspondingly swift.

The Zuider Zee, on the other hand, particularly that portion which lies south of a line drawn from Enkhuizen to Stavoren, has a remarkably even surface combined with relatively shallow depth. The depth varies from zero at the coastline to a maximum of about 16 feet below N.A.P. (Nieuw Amsterdamsch Peil, which is the average sea-level

datum for Holland) in the centre, and it is only to the west of the island of Urk that there is a slightly deeper channel of about 20 feet. The tidal range, moreover, is very moderate and does not amount to more than from 4 in. to 15 in.

Between the two basins lies an intermediate zone, the western section of which, called the Wieringen Lake, has a depth exceeding 14-15 ft. at low water, and probably represents a sheet of inland water which was in existence before the incursion of the sea.

The shallow depth and sheltered situation of the Zuider Zee have caused it to be the subject of speculative interest on the part of Dutch engineers for a long time past. Schemes of land reclamation, dear to the heart of the Hollander and indeed essential to the national development, have been propounded for several centuries. The earliest of which a plan is in existence dates from the seventeenth century. In the year 1667, Hendric Stevin published a treatise ("Wisconstich Filosophisch Bedryf") in which he proposed to link up the Frisian islands by means of dykes across the intervening channels. Nothing came of this proposal, the difficulties being too considerable. Various subsequent schemes were found either to be impracticable or were beyond the resources of the country at the time.

It is not until modern and comparatively recent times that we come to the definite promulgation of a feasible scheme which, after some vicissitudes of discussion and legislation, is now in process of being realised. In the early eighties of last century, Mr. Buma, a Frisian member of the Chamber of Deputies, was instrumental in establishing a Zuider Zee Association having for its object the institution of a technical and financial investigation into schemes for the enclosure of the Zuider, Wadden, and Lauwers Zees and their partial reclamation. Dr. C. Lely was appointed civil engineer in charge, and between 1887 and 1891 he published a series of eight reports, in which all the details of a properly conceived plan were thought out and determined. It was demonstrated that the best solution of the problem would be to construct, first of all, an enclosing dyke or embankment from the province of North Holland, by way of the island of Wieringen, to the Frisian coast near Piaam, and then to proceed with the reclamation of four *polders* or marshlands so defined as to leave a sufficient area of water to form an estuary for the effective discharge of the River Yssel. The length of the enclosing dyke was to be 18½ miles and the enclosed area would amount to 360,000 hectares (889,560 acres), of which 232,000 hectares (573,272 acres) would be reclaimable. The total cost was estimated at 190 million guilders, say £16,000,000.

A State Commission was appointed in 1892 to examine the scheme, and in 1894 a favourable report was presented subject to some slight modification of the plan in detail. Here for a time the matter rested. On two occasions, in 1901 and 1907, bills were introduced into Parliament for the purpose of giving effect to the Commission's recommendations, in whole or in part, but without avail. Finally, in 1918, an Act was passed authorising the enclosure and partial reclamation of the Zuider Zee. By a Royal decree of July 16 of that year, the Zuider Zee Council referred to in the Act was instituted to render advice and assistance to the Government in the further preparation and execution of the work and a technical service was at once created.

Photo.] [*Royal Dutch Air Co.*

FIG. 2.—Aerial view at Den Oever showing main dyke extending to left, and in centre, dyke, enclosing North-West Polder, stretching towards Medemblyk on horizon. In the foreground, foundations for sluices and lock, with working depot and harbour.

The Act, which is based on the plans approved by the 1892 Commission, prescribes the construction of an enclosing dyke and decrees that the work shall be carried out at the expense of the State. It does not specify the number and extent of the polders to be reclaimed, leaving these to be determined by later investigation.

Constructive work was actually begun in 1920 after some preliminary operations in the preceding year. The Amstel Diep lying between the island of Wieringen and the mainland was partially filled and the general level of the bed of the channel raised to a height of 15 feet below N.A.P. so as to provide a foundation on which the enclosing dyke could be constructed. In the following year, 1921, a works harbour with storage depot was constructed at the easternmost point of the island of Wieringen close to the little village of Den Oever. During the next four years, 1922–1925, the work proceeded but slowly, the Government feeling that the condition of the national exchequer would not permit of the expenditure of large sums of money. In 1925, however, restrictions were removed. Two Acts were passed to accelerate the progress of the work, and it was decided to proceed forthwith with

the construction of the great enclosing dyke from Weiringen to the Frisian coast and with the reclamation of the first polder, known as the North-western or Lake Wieringen Polder.

Since then progress has been steady and continuous. I visited the works in the early part of July and found that great strides had been made. By the courtesy of Heer J. A. Ringers, the managing director of the contracting company for the works, I had an opportunity of traversing the whole extent of operations along the western side of the Zuider Zee. The island of Wieringen is now integrally connected with the mainland, and where formerly was the Amstel Diep I motored over a properly made and substantial roadway protected on the seaward side by a stone pitched embankment. Southward from Den Oever towards the town of Medemblyk, the enclosing dyke (a view of which is given in Fig. 2) was well advanced and at the point of completion. Within a few weeks of my visit it presents an unbroken front and an area of 50,000 acres (the North-West Polder—see Fig. 1) has now been enclosed for reclamation—a process which will, of course, require some little time to effect, as the water has to be pumped out and the land prepared for cultivation. The seasoning and purification of the soil must necessarily be a slow process after its saturation for so long a period with salt water. An agricultural commission has estimated that a period of six or seven years must elapse before the polders can reach their full cultivable value. It is expected, however, from results obtained on a small experimental polder with the use of rape seed, that productivity will begin with the lapse of a couple of years.

The main dyke (the eastern extremity of which is to be seen in Fig. 3) connecting the island of Wieringen with the Frisian coast is proceeding apace and may be expected to be completed about the year 1934. It is being formed of earthwork (clay hearting and sand backing) and is being given a base width of about 120 metres (say 400 feet) and a height at the crest of 7·25 metres (24 feet) above N.A.P. As in the case of the dam across Amstel Diep, it will be provided with a roadway for vehicular traffic and space also for rail locomotion, as may be required. Locks are to be installed to permit the passage of shipping to and from the Yssel Lake (as the enclosed water area will be called), the level of which will be maintained at about 16 inches below N.A.P. The surplus water of the lake is to be discharged at low tide through sluices in the dyke. Sluice gates are being constructed at two points, at Kornwerderzand, an artificial location, about $2\frac{1}{2}$ miles from the Frisian coast and also just to the east of the island of Wieringen. Each sluice gate will have a width of 40 feet, and the total breadth of sluice opening will be 1000 feet.

Reclamation work is comprised under the following four sections, one section lying to the east and the remainder to the west of the Yssel Lake:

N.W. Polder	20,000	hectares	or	50,000	acres
S.W. ,,	56,000	,,		140,000	,,
S.E. ,,	95,000	,,		235,000	,,
N.E. ,,	53,000	,,		130,000	,,
	224,000			555,000	

As the total area of the Netherlands is about 3,262,000 hectares or 8,060,000 acres, it will be seen that as a result of the reclamation work in the Zuider Zee the area of the country will be increased by about 7 per cent. As a matter of fact, the arable land will receive an increment of 10 per cent, a very substantial addition to its productive capacity. The cost of the enclosure works is estimated approximately at £7,500,000, and of the reclamations, including the drainage of the polders and their upkeep until full productivity is attained, at something more than £30,000,000. It is a great financial enterprise for a small country like Holland, and one cannot but be impressed by the courage of its promoters, as well as by the careful and systematic arrangements which have been made to carry it through to a successful conclusion.

Photo. [*Royal Dutch Air Co.*

FIG. 3.—Aerial view of main dyke, with foundations for sluices and lock at Kornwerderzand. Frisian coast in background.

Apart from personal observation and conversation and correspondence with Heer Ringers, to whom I tender my acknowledgments and thanks, I have derived much information on the subject on which, of course, a great deal more could be written, from publications of the State Department of the Waterstaat. The photographs have been courteously furnished by Heer Ringers.

Botanical Records of the Rocks: with Special Reference to the Early *Glossopteris* Flora.[1]

By Prof. A. C. SEWARD, F.R.S.

EARLIER CHAPTERS OF THE HISTORY OF THE PLANT WORLD.

IT may be helpful as a preliminary to my treatment of certain aspects of plant-life in former ages to glance at a table of contents of the geological history of the world. The crystalline rocks classed by geologists as Archæan represent inconceivably ancient land surfaces on which were accumulated vast piles of detrital material furnished by agents of erosion, and from time to time products of volcanic activity. Plants may have lived on the Archæan, or pre-Cambrian, continents; they probably did, but as yet we have no certain knowledge of them.

Passing higher in the geological series to the marine sediments and associated lavas and volcanic ash included in the Cambrian, Ordovician, and Silurian systems, we find clear evidence of the existence of lime-secreting Algæ, the precursors of some of the modern reef-forming seaweeds, and, in Silurian strata, a few traces of plants which probably lived on dry land. It is true to say that as yet we know practically nothing of the terrestrial vegetation of the world before the beginning of the Devonian period.

Attention has been directed by many writers to the recently acquired knowledge of the floras that have left well-preserved samples in rocks of the Devonian period: we speak of Devonian plants as the oldest known relics of terrestrial vegetation; but we cannot believe that in them we have the first of a succession of colonists which spread over the face of the earth. Whether they are regarded as the modified descendants of more ancient types, which evolved in the sea and afterwards accommodated themselves to existence above the tides; or whether we prefer to think of Devonian plants as descendants of Silurian or still older progenitors, the fact remains that their ancestry is shrouded in mystery. Stress has been laid on certain morphological features presented by members of the older Devonian floras; on the other hand, we must remember that the best-known of these extinct plants lived in swamps and under conditions that were favourable to their preservation as fossils. We know only in part.

A few plants have been recorded from Devonian rocks in South Africa, but the records so far obtained from beds below the Karroo system are very disappointing. Further research may yield valuable results.

Leaving the Devonian period we pass to the Carboniferous and Permian periods, and here there is much to discuss which has a special application to South Africa. At many localities abundant *disjuncta membra* of plants have been found in sediments deposited in shallow water near the coastlines, and in volcanic ash flung from craters over forest-clad regions beyond the reach of the sea. This Lower Carboniferous vegetation, though more varied than that of the latter part of the Devonian period, was its direct derivative. Identical genera and identical, or at least very closely allied, species have been found in north-eastern Greenland, in Spitsbergen, in Europe and North America, in South America and Australia.

Many instances of the wide geographical range of early Carboniferous plants might be given: it is evident that during the first half of the period the vegetation of the world, so far as we can tell, was less diversified than it is at the present day. Genera such as *Lepidodendron* and allied forms, *Asterocalamites*, the earliest, well-defined example of an Equisetalean type, *Rhacopteris* and *Clepsydropsis* among the ferns, *Cardiopteris*, which may be a pteridosperm, were common to both hemispheres. Here again we lack data from South Africa.

During the latter part of the Carboniferous period and the first half of the Permian period the vegetation of North America and Europe was also more uniform in composition than the floras of the old and new world to-day. Far-travelled members of this northern vegetation were discovered a short time ago in Sumatra and the Malay Peninsula: their geological age is either uppermost Carboniferous or Lower Permian. The coal seams of China, though probably rather younger in age than the richest seams of Europe and America, consist of the altered debris of forests which had spread across the world.

Before leaving the northern hemisphere attention must be directed to the records of a late Palæozoic flora scattered over a broad region stretching from northern Russia to the Pacific coast: its most striking peculiarity is the presence of *Gangamopteris* and some other types characteristic of the *Glossopteris* flora, which presumably, as immigrants from the southern continent, had found a passage across the Tethys Sea.

THE *GLOSSOPTERIS* FLORA AND THE LATE PALÆOZOIC ICE AGE.

At the stage of geological history we are considering, a broad expanse of water—the Tethys Sea—formed a west and east boundary between the northern continent and Gondwanaland. Let us now pass across the Tethys and take note of the conditions farther south. In that part of Gondwanaland that is now South Africa, as elsewhere in the southern hemisphere, there is proof of a long-continued reign of ice-sheets and glaciers. The occurrence of well-preserved impressions of plants at the base of the old boulder beds at Vereeniging shows that some members of the *Glossopteris* flora coexisted with the ice. The problem which I now propose to discuss is this: At what period did the Ice Age begin, and what is the geological age of the first phase of the *Glossopteris* flora?

The most important of recent contributions to the

[1] From the presidential address to Section K (Botany) of the British Association, delivered at Johannesburg on Aug. 1.

vexed question of the date of the Gondwanaland Ice Age and of the initial stages of the *Glossopteris* flora is from Prof. Schuchert, of Yale University (*Bull. Geol. Soc. America*, vol. 39, pp. 769-886; 1929). Though this is scarcely a suitable occasion for a full discussion of a controversial subject, it is not inappropriate to consider a few of the arguments advanced by the distinguished American geologist.

Prof. Schuchert concludes the summary of his views with these words: "It is therefore certain that the widely spread tillites (that is, the old boulder clays) are of Permian time and in all probability of late Middle Permian age. In any event, not even those of Australia can be of Upper Carboniferous time." He bases this very definite pronouncement mainly on the fossil animals obtained from marine strata associated with the Palæozoic boulder beds. After referring to views expressed by the late Dr. Arber and by myself that "the lowest beds containing remains of the *Glossopteris* flora are, in all probability, homotaxial with the Upper Carboniferous rocks of the northern hemisphere", he adds: "They believe that while the cosmopolitan Upper Carboniferous Flora was living in the northern hemisphere, the *Glossopteris* one was in existence south of the equator".

My view is that no Upper Carboniferous flora was in the strict sense cosmopolitan. Prof. Schuchert continues: 'This contemporaneity of the very different northern and southern floras . . . can not be maintained when the floras are checked into the stratigraphical and marine records. We will repeat", he adds, "that even though there are in none of the continents of the southern hemisphere, other than the west coast of South America, any known plant-bearing rocks of Upper Carboniferous age, yet in this single occurrence there is at hand a small plant assemblage of the cosmopolitan Upper Carboniferous Flora". These South American plants were assigned by Mr. Berry to an Upper Carboniferous horizon, but both Dr. Gothan and myself believe them to indicate a Lower Carboniferous age.

The glacial deposits are stated by Prof. Schuchert to be one of the finest means of making definite time correlations from continent to continent, but in another place he admits that the scattered tillites of Gondwanaland, though regarded as the products of one glacial age, are not all exactly of the same age. It may well be, he adds, "that the basal moraines in south-eastern Australia are somewhat older than those of other continents, as maintained by David and Süssmilch; but by no possible chance can the Australian tillites be stretched into the Upper Carboniferous, nor does it seem possible to place them even below the Middle Permian". Here we have an assertion which challenges criticism.

I am indebted to my friend Sir Edgeworth David for information on the succession of boulder beds and fossil-bearing strata displayed in a section in the Hunter River district of New South Wales: this section gives the sequence of events antecedent to and during the existence of the *Glossopteris* flora. In brief, the evidence furnished by the Australian sections indicates the existence of a flora, which in the northern hemisphere is accepted as Lower Carboniferous, at a stage followed by strata which have furnished the oldest members of the *Glossopteris* flora. The break in succession at this level, between the Kuttung and Lower Marine series, is regarded by Schuchert not merely as evidence of shifting of the scenes inaugurating a new type of vegetation—the *Glossopteris* flora—but also as representing a long interval of time during which rocks of Upper Carboniferous age were being deposited in the northern hemisphere. It is difficult to believe that events which occurred during the latter half of the Carboniferous period are entirely lacking in the geological records not only of Australia, but also of India and South Africa. The more probable view, in my opinion, is that the Lower Marine Series and the corresponding strata in Western Australia containing *Paralegoceras* are homotaxial with the Upper Carboniferous system in Europe and North America.

There has been much discussion on evidence, relevant to the age of the Glacial period and the *Glossopteris* flora, derived from the Indian Peninsula and from regions farther north. Prof. Schuchert, after mentioning the discovery of *Gangamopteris* and *Glossopteris* "in marine strata beneath fossils of the Productus limestone", goes on to say that this discovery proves that the *Gangamopteris* flora is of Upper Permian time.

The age of the Productus Limestone is a determining factor in Prof. Schuchert's contention, and as the evidence is outside my own province, I consulted Dr. Dighton Thomas, of the British Museum, who has made a special study of the palæozoological data bearing on the correlation and age of the Carboniferous and Permian rocks with particular reference to the problems under dispute. Dr. Thomas points out that "the question of the lower limit in age of the Productus Limestone series, and of the beds below them as far as the boulder bed, hinges on the means of determining the age of the Amb to Virgal series [of the Salt Range]". In his letter of April 19, from which he kindly allows me to quote, he goes on to say that the best means of settling the age of the Salt Range beds is furnished by the Brachiopods, a group which Prof. Schuchert "practically ignores". The evidence of the Brachiopods "would point to the Amb series (that is, essentially the lower Productus Limestone) being of Lower Permian age at the latest, and I cannot agree with Schuchert's reference of these beds to the Upper Permian". It follows that the underlying Speckled Sandstone, classed by Schuchert as Middle Permian, is "of high Carboniferous age".

In the same letter Dr. Thomas quotes the following statement by Prof. Schuchert: "The interregional correlations are made, however, not so much from the evolution of the Brachiopods as from that of the Ammonites", and, Dr. Thomas adds—"But there are no Ammonites in the succession under dispute in New South Wales, nor are there any in the whole Salt Range Series between the boulder bed and the base of the *Xenaspis carbonarius* zone; nor in South Africa, nor in South America". I have quoted only in part from Dr. Dighton Thomas's letter in the hope that he will

publish in full his criticism of Prof. Schuchert's views.

We now pass to South Africa : as already stated, at Vereeniging impressions of *Gangamopteris* were found between the base of the Dwyka boulder bed and the underlying pre-Devonian platform. The Dwyka shales above the tillite have yielded *Eurydesma* and a crustacean, *Pygocephalus* : the latter is believed by Mr. Woods of Cambridge to indicate an Upper Carboniferous horizon. Prof. Schuchert attaches no importance to the crustacean. At a higher level is the so-called White Band, which, as Mr. Du Toit points out, affords a valuable connecting link between the South American and South African succession of strata.

An important consideration raised by the South African beds is the occurrence at Vereeniging of *Glossopteris* and *Gangamopteris* with *Lepidodendra*, *Sigillaria*, and *Psygmophyllum*, which furnish a strong argument in favour of an Upper Carboniferous or at latest a Lower Permian age. An assemblage of plants such as that discovered by Mr. Leslie at Vereeniging has never been found in Middle Permian beds : but Prof. Schuchert definitely states that the tillites which occur below the Vereeniging plant beds are not older than Middle Permian. A collection of plants recently submitted by Dr. Maufe to Mr. John Walton includes species of *Glossopteris* in company with several forms of *Sphenophyllum*, *Pecopteris arborescens* and other plants : comparison with northern floras indicates an age which is at the latest Lower Permian and not improbably near the top of the Upper Carboniferous. The evidence furnished by these and other South African plant-beds is directly opposed to Prof. Schuchert's view.

The summary, though necessarily very incomplete, may enable us to reconstruct in broad outline the closing scenes in the Palæozoic era on the continent of Gondwanaland. In the course of this phase, ice-sheets and glaciers spread from the remote south beyond the equator : lands that are now tropical were then ice-bound. The world was divided into at least two sharply contrasted regions, a northern region where rank vegetation covered thousands of square miles of swamp and low hills, and a vast southern continent where another and less luxuriant vegetation flourished in proximity to retreating glaciers.

An argument stressed by Prof. Schuchert in the presentation of his case for the Middle Permian age of the *Glossopteris* flora and the boulder deposit is based on the marine fossils. The only piece of evidence furnished by marine fossils available in the Indian Peninsula is unfavourable to his view. Moreover, the *Paralegoceras* of Western Australia and the South African crustacean *Pygocephalus*, support the opinion that the *Glossopteris* flora was evolved before the close of the Carboniferous period. If the *Glossopteris* flora is not older than Middle Permian, we are left in complete ignorance of the state of the plant world in Gondwanaland during the long interval between Lower Carboniferous and Middle Permian time.

I have dwelt longer than I intended on certain questions connected with the *Glossopteris* flora, but the publication of Prof. Schuchert's stimulating, and I would add, provocative article, is my excuse. He has stated his case clearly though not convincingly and has collected a mass of material for which many of us are grateful. We are not yet in a position to make positive statements on the age of the *Glossopteris* flora or on the precise correlation of the late Palæozoic plant beds of Gondwanaland and those north of the Tethys Sea. More evidence is needed. Meanwhile, I am not shaken in my opinion that if we could transport ourselves back through the ages into a forest of the northern hemisphere in the latter part of the Upper Carboniferous period, and thence travel by aeroplane to the land that is now South Africa, we should find retreating glaciers and a vegetation in which *Glossopteris* and *Gangamopteris* were prominent plants.

A Critical Stage in the History of the Plant World.

There is another exceptionally interesting problem worthy of South African investigators. It is this : the closing stages of the Palæozoic era in the northern hemisphere were marked by widespread crustal displacements. Crustal movements are a determining factor in the evolution of the plant kingdom : in other words, geological revolutions afford an impressive example of the co-ordination of the inorganic and organic worlds, a theme which has been elaborated by General Smuts in his fascinating book " Holism and Evolution ".

The vegetation of the early part of the Permian period, though generally similar to that of the latest stage of the Carboniferous period, was relatively much poorer in genera and species. There were connecting links between the Palæozoic and the early Mesozoic floras, but in the main the two floras differed widely from one another. The more orderly succession of plant-bearing strata in most parts of the southern hemisphere justifies the hope that an intensive and comparative study of the transitional stage between the earliest and the latest phase of the *Glossopteris* flora will furnish valuable data. In this field of work Mr. Du Toit has shown the way : may his example be followed.

Fossil Plants as Tests of Climate.

I now propose to intercalate a few words on another question of general interest. Fossil plants of many different ages frequently occur in unexpected and, from some points of view, very inconvenient places where they raise problems which have so far baffled the ingenuity of students. The best examples are from Arctic regions, and there is also the rich Jurassic flora described some years ago by Prof. Halle from the edge of the Antarctic region. In brief, there are numerous examples of fossil floras from the Arctic or Antarctic which are composed of genera and of plant forms regarded as characteristic of temperate or sub-tropical habitats at the present day. If we plot on a map of the Arctic regions the distribution of ancient floras, it becomes clear that no shifting of the earth's axis,

even if this favourite device were admissible, would give a satisfactory explanation of the contrast between the past and the present.

Discarding as inadequate, and as a method wholly displeasing to astronomers, an attempt to create geographical environment consistent with palæobotanical facts by altering the position of the north pole, we turn to the alternative of rearranging, within the Arctic circle, the distribution of land and sea and the consequential shifting of cold and warm oceanic streams. Dr. C. E. P. Brooks suggests a possible rearrangement of land and water which, he believes, would go some way towards the provision of climatic conditions such as the fossil plants of the Tertiary period appear to demand; but it would seem from a more recent contribution by Dr. G. C. Simpson that we cannot hope to obtain all we need, or nearly all we need, by any method of redistribution of land and sea on the assumption of a fixed pole, and without recourse to Wegener's hypothesis of drifting land areas.

We are left with two other alternatives: the adoption of Wegener's views or some modification of them; or the possibility that plants are less trustworthy as indices of climates than has generally been supposed. It may be that a combination of these two methods of attack is the clue to our problem. Let us take the second first: assuming that the ferns to which reference has been made flourished on the parallels of latitude where their remains have been found, and assuming such amelioration of the present Arctic conditions by a rearrangement of land and water as meteorologists permit, there must have been in the past, as there is to-day, a long and relatively dark period of sleep, and a summer no longer than the growing season now available for the almost miraculous development of Arctic plants. Can we imagine, to take one instance, the Cretaceous flora of Greenland enduring a sunless Arctic night more than six months in duration?

There is another, and to my mind an important and neglected consideration; we are too prone to speak of such a genus as *Gleichenia* as tropical because it happens to be one of the commoner ferns in tropical countries; but like many other genera characteristic of the warmer parts of the world, it includes species which grow vigorously at an altitude of 10,000 ft.-12,000 ft. where the climate is by no means tropical. Is it not legitimate to suggest that a plant that is now confined to the tropics may at a much earlier stage of its career have been able to live under other conditions? Is it unscientific to express the opinion that we may think of plants not only as organisms which have changed in form and structure in the course of thousands or millions of years, but also as organisms which have changed in their susceptibility to external factors?

I suggest that there is a tendency to rate too highly the value of extinct plants as guides to climatic conditions, and I would emphasise the desirability of obtaining more definite information than is at present available on the effect of continuous light and continuous darkness, under suitable temperatures, on plants which do not at present occur in Arctic habitats. Even if the foregoing suggestions have any merit, and if we have underestimated the capacity of plants to survive Arctic seasons, there is still a serious obstacle to surmount before it is possible to imagine, let us say, the Rhætic vegetation of Scoresby Sound and that of southern Sweden flourishing in regions separated from one another by at least ten degrees of latitude.

Wegener speaks of the upper portion of the earth's crust as travelling in an easterly and westerly direction; he also assumes a slight movement of the poles. If it is permissible to postulate a drifting of fractured slabs of the crust in a north and south direction, we can then think of the disunited pieces, now occupying positions more or less remote from one another, as the severed portions of a formerly compact region. To take a concrete example: the Rhætic plant beds of eastern Greenland, now remote from those of Sweden, may formerly have been portions of one mass well to the south of the Arctic circle. This may be merely a figment of the imagination; but such evidence of correspondence, both in the succession and nature of the stratified rocks and in the fossil contents, as Mr. Du Toit has obtained from a comparative study of the rocks of South America and South Africa, or as Mr. Harris is finding in his comparison of the Greenland and Swedish Rhætic strata, is arresting enough to make us pause before abandoning the principle of continental drift.

Palæobotany as a Key to the Present Distribution of Plants.

If time allowed it would be tempting to deal with still another aspect of palæobotany; the importance of a critical study of the floras which immediately preceded the Pleistocene Ice Age. Progress made in recent years in the improvement of methods of deciphering the relics of plants of other days increases the confidence with which it is possible to recommend, as a promising field of work, the investigation of Tertiary floras. The Tertiary floras were more uniform than the floras of to-day. We cannot understand the present distribution of human races if we confine attention to the present, nor can we appreciate the significance of the geographical distribution of floras and their composition unless we consult the herbaria of the rocks.

Low Frequency Sound Waves and the Upper Atmosphere.

By E. H. Gowan.

THE transmission of low frequency sound waves, such as those from explosions, to very great distances has been an accepted fact for some time, but for careful investigations it was inevitable that mechanical instruments should eventually replace the ear in receiving the waves. These instruments have the advantage of being more certain, more accurate, and of producing a permanent record. Some types show the form of the wave, and all are more sensitive to the longer wavelengths which may be completely missed by the ear, even though they are not quite outside the

audible limit. Those beyond this limit are actually the more useful because they tend to be less strongly absorbed in their passage through the air.

One of the most important instruments used is the hot wire microphone. A suitable closed box has in one wall a small orifice in which is placed a fine wire coil, heated by an electric current. This filament forms one arm of a sensitive resistance bridge, of which disturbances of balance can be shown by a short period recording galvanometer. The passage of a wave causes a draught to flow in and out of the orifice, cools the wire, thus changing its resistance and destroying the balance of the bridge. A moving film shows the deflection of the galvanometer beside time marks which are recorded automatically at suitable intervals.

Another recording instrument is the undograph, which has received wide use and commendation in Germany. A steel fibre is fastened to a thin mica sheet along an axis of symmetry, and is arranged to act as a taut suspension. The sheet swings freely, one half, with as little clearance as possible, in an opening through the wall of a large air-tight box; the other half swings in a small chamber, providing some damping, but is protected from the incoming wave. The motion is shown by a beam of light reflected from a mirror on the mica, and the optical, mechanical, and photographic arrangements for recording this, along with the necessary time marks, are all contained inside the box. The natural period of the system is of the order of a second, and the records obtained from waves just below the audible limit are very good, and easily distinguishable from accidental and wind disturbances because they are approximately sinusoidal.

A comparison of the two instruments shows that there is not much to choose between them in the matter of maximum sensitivity, though the undograph is less disturbed by wind and other accidental causes, and can perhaps be used in an adjustment nearer its maximum. The microphone gives a non-symmetrical record and does not show up the form of the wave. On account of greater complication it is only with difficulty made portable, but the undograph is very conveniently self-contained. The fact that the undograph is much the cheaper instrument is perhaps after all the greatest point in its favour.

A large body of observations has resulted from great activity in Germany,[1] culminating in a systematic series of experiments under the Notgemeinschaft der Deutschen Wissenschaft. Early results indicated a marked seasonal effect, the minimum distance at which sound was heard in the outer zone being 110 km. in winter and 190 km. in summer. Corresponding distances for maximum intensity were 125 km. and 230 km. The later results followed a searching investigation of the effect on the consistency of the observations of kind and amount of explosive, its position with respect to the ground, the nature of the soil, and methods of detonation. The velocity for the inner zone is normal for the temperature of the air at the ground, 330-340 m./sec., but the apparent velocity for the outer zone is lower than this, 280-300 m./sec. The conclusion is that the sound has travelled a much longer path through the upper atmosphere. In different directions from the source of the wave the time of travel to the same distance in the outer zone varies by so much as 35 sec. This is attributed to upper air winds. It can be shown that the apparent surface velocity of the returned ray, measured by means of two instruments grouped a few hundred metres apart, on a line containing the source, is equal to the velocity at the highest point of the trajectory. As one also knows, from the interval between reception at the two instruments, the angle at which the ray comes down, an estimate of the height is possible. The average results of several methods of analysis show that at about 40 km. the velocity must be in the neighbourhood of 340 m./sec.

Several theories have been put forward to account for the existence of one or more zones of abnormal audibility. The effect was at first ascribed to strong winds in the stratosphere, but so soon as it was established that waves were received in all directions, this idea was abandoned as untenable. It was next suggested that the increase in velocity was due to a settling out of the heavier gases and the relative predominance of hydrogen and helium at the heights where bending takes place. From other considerations, however, it seems unlikely that there is much change in composition below 80-100 km. Even if 25 per cent of the lighter gases were possible at 50 km., the time of travel is not sufficient for the wave to reach the necessary height, and also the diminution of intensity would be too great in passing through regions of such low pressures.

The ordinary formula for the velocity of sound in a gas is valid only if the amplitude of the wave is small in comparison with the total pressure. If this is not so the values are much greater, and in the immediate vicinity of explosions, velocities so great as 900 m./sec. have been observed. It has been claimed that the velocity increase in the upper regions is due to such a breakdown of the ordinary formula, but it is perhaps doubtful that the total pressure falls off more rapidly with height than the amplitude falls off with distance from the source, when the smallness of the average angle is considered. Though this last explanation may perhaps claim a share of the responsibility, and cannot be peremptorily dismissed, another has been more widely accepted as being primarily responsible. The supposition that above 30 km. the temperature of the atmosphere increases again with height until it reaches, or even surpasses, ground temperature, is sufficient in itself to account for the abnormal zone of audibility. The above-mentioned velocity of 340 m./sec. at 40 km. indicates a temperature of about 15° C. there. Such

[1] British observers have in the past few years been working with the hot wire microphone, registering the waves from experimental gunfire at Shoeburyness. It is not my intention, however, to treat these results in any detail here. On p. 114 of the second report of the Committee on Solar and Terrestrial Relationships, International Research Council, will be found an admirable summary by Dr. F. J. W. Whipple.

high temperatures in the upper atmosphere were first indicated by a study of meteors, and it has recently been shown that the absorption of solar energy in the ozone layer (centre of gravity about 45-50 km.) is responsible for their maintenance. This explanation, supported as it is by evidence from two independent sources, seems likely to remain as the most important in the field.

The experimental investigation of conditions in the upper air is full of difficulty, and one of the most fruitful and powerful methods seems to be by the use of these low frequency sound waves. The institution of consistent and systematic explosions to be observed by registering instruments in groups of two as above, spaced, say, 10 km. apart so as to cover the whole abnormal zone on a suitably chosen diameter (with the addition, if feasible, of a radius at right angles), could give much information about the seasonal and possible diurnal variation of the radius of the inner edge. Perhaps a simpler method of getting information about the upper winds would be the grouping of three instruments in a triangle, a few hundred metres apart, enabling both the vertical and horizontal angles to be measured. A most important step is to have work of this sort undertaken at representative and suitable parts of the world. Increases in our knowledge of the physics of the upper air are almost certain to result from the co-operation of workers in various countries, once the highly important problem of defraying the cost is solved.

Obituary.

Dr. W. G. Duffield.

IT is but a few weeks ago that we were giving a welcome to the first publication (*Memoirs*, vol. i. No. 1), issued from the Solar Observatory of the Australian Commonwealth, at Canberra; and now to our deep regret comes the news of the death, on Aug. 1 after a brief illness, of Dr. Walter Geoffrey Duffield, the Director of the Observatory.

Dr. Duffield was the son of the late Mr. W. Duffield of Adelaide, and a grandson of Senator Walter Duffield, one of the first members of the South Australian Parliament. He graduated first at the University of Adelaide in 1900, and then at Cambridge, where he passed out in the Mechanical Sciences Tripos in 1903. He married Miss Doris Boult, of Adelaide. Later, at the University of Manchester, from which he received the degree of D.Sc. in 1908, he became an honorary research fellow, and worked at the subject of the effect of pressure upon arc spectra. He held a Mackinnon Studentship awarded by the Royal Society in the years 1906 and 1907, and under the stimulating influence of Sir Arthur Schuster he communicated four memoirs on the subject named above to the *Transactions* of the Royal Society in the years 1907–15, extending thereby the work of Humphreys and Mohler, especially in relation to the metals iron, copper, silver, gold, and nickel, and studying the arc spectra of those metals at pressures ranging from 1 atmosphere to 101 atmospheres.

In 1911, Duffield was appointed to the professorship of physics at University College, Reading, a post which he held until 1923. Though the claims on his time and energies were considerable, both as professor and as dean of the Faculty of Science, he found time for research work and for encouraging such work amongst his post-graduate students. Among other subjects he studied the electric carbon arc from the point of view of the consumption of carbon under varied conditions of current strength and length of arc, and their influence on the luminosity of the arc. Papers on the subject were published in the *Proceedings* of the Royal Society, vol. 92.

In 1912, Duffield had discovered the existence of minute repulsion between the poles of an electric carbon arc. Seven years later he carried out, with the assistance of two of his post-graduate students, a beautiful set of experiments designed to eliminate all extraneous disturbing forces. He succeeded in measuring the outstanding force of repulsion though it was only of the order of a dyne, and showed that it was due to the recoil consequent upon the projection of electrons from the poles (*Trans. Roy. Soc.*, A, vol. 220). A year later he had extended the observations to the case of metal arcs.

During the War Duffield served, despite ill health, as captain in the Royal Air Force.

Another piece of Duffield's research work may be mentioned here, namely, his attempt to determine the value of gravity over the ocean, on a voyage to Australia and back, in 1914. His results were published in the *Proceedings* of the Royal Society, vol. 92. A vivid account of the preparations for the work and the difficulties experienced was given in the report of three pages in the British Association Report for 1915, p. 48. The main object of the research was to obtain results bearing on the theory of isostasy. Duffield showed undaunted perseverance in discovering and remedying leaks in the four barometers which were involved in his operations in the refrigerators of the s.s. *Ascanius*. The whole-hearted assistance which he evoked from all those with whom he came in contact in his enthusiastic efforts was a splendid testimonial to the fervour of his devotion.

When the British Association in 1908 appointed a committee with Sir David Gill as chairman to aid the work of establishing a solar observatory in Australia, Dr. Duffield was chosen as secretary. The matter was one requiring considerable tact and perseverance in addition to a knowledge of local politics and local conditions. The first report of the committee was published in the British Association Report for 1909, and contains a statement of the history of the movement. It sets forth the grounds on which the committee urged the participation of Australia in the international co-operation in solar research then in full activity. Dr. Duffield made three voyages to Australia with such good results that in 1914, when the Associa-

ion met in Australia, the committee, reinforced by new members, was received by the Prime Minister and was assured of favourable consideration, so far as was possible at the outbreak of the War.

It was not until 1923 that the decision to found an observatory at Canberra was ultimately reached, and a not unnatural sequel to the multifarious activities of Dr. Duffield was that he was elected to be the first Director, but it is within the knowledge of the present writer that it needed considerable persuasion to induce him to accept the post, so convinced was he that his own tastes and studies could not be regarded as any qualification for the post of astrophysicist. It was a difficult task that he undertook, and we are scarcely in a position yet to estimate the degree of success that he had in carrying out his aims for the equipment and initiation of the work at the observatory on Mount Stromlo. He has many friends who will deeply deplore his premature death, and will think with warm sympathy of his wife and children. H. F. N.

WE regret to announce the following deaths:

Mr. Arthur Berry, O.B.E., vice-provost of King's College, Cambridge, author of a "Short History of Astronomy" and of many mathematical papers, on Aug. 15, aged sixty-six years.

Mr. Anthony Collett, author of "The Heart of a Bird" and other natural history books, and a member of the staff of the *Times*, on Aug. 22, aged fifty-two years.

Mr. Walter Heape, F.R.S., a distinguished worker on embryology and on the comparative physiology of the generative system, on Sept. 10, aged seventy-four years.

Mr. Montague Hill, C.I.E., formerly chief conservator of forests in the Central Provinces, India, on Aug. 12.

M. Auguste Lebeuf, director of the Observatory of Besançon, known for his work on chronometry and celestial mechanics, aged seventy years.

Sir Seymour Sharkey, consulting physician to St. Thomas's Hospital and president in 1904 of the Neurological Society, on Sept. 6, aged eighty-two years.

Sir Edward Maunde Thompson, G.C.B., director and principal librarian of the British Museum from 1888 until 1909 and author of "Introduction to Greek and Latin Palæography," on Sept. 14, aged eighty-nine years.

Dr. Naomasa Yamasaki, professor of geography in the Imperial University of Tokyo, member of the Imperial Academy, chairman of the National Committee on Oceanography of the Pacific, and chairman of the Division of Geology and Geography of the National Research Council of Japan, on July 26, aged fifty-nine years.

News and Views.

DR. BONHOEFFER'S discovery that it is possible to separate out two distinct kinds of molecules from ordinary hydrogen, to which reference was made in NATURE of April 20 (p. 621), would appear, from Press reports of the Minneapolis meeting of the American Chemical Society on Sept. 10, to have formed the subject of a further communication there by Dr. Bonhoeffer himself. Dr. Bonhoeffer has not attempted to split up the proton, the nucleus of the hydrogen atom (H), but has simply subjected hydrogen gas (H_2), as usually prepared, to treatment similar to that employed in many other physico-chemical processes. It appears that he has not only shown that it consists of two molecular species—each, however, with the same formula, H_2—but has also been able to prepare at least one form in a practically pure state, and to find a number of its physical constants, which are not the same as those of the mixture which is ordinary hydrogen.

THESE experiments with hydrogen have been inspired by the new mechanics, by means of which it was predicted that two protons and two electrons could link together to form a normal hydrogen molecule in two quite different ways. Other evidence for this admittedly revolutionary idea comes from the analysis of the multilinear secondary—band—spectrum of hydrogen, in which two types of terms have been found, analogous to two types found in the corresponding line spectrum of helium, which may be looked upon in one sense as a hydrogen molecule with the two nuclei coincident: the names 'parahydrogen' and 'orthohydrogen' have been coined by reason of this analogy with 'parhelium' and 'orthohelium'. Whether or not it will prove possible to analyse other diatomic—or more complicated—gases in the same way can scarcely be stated at this stage. Dr. Bonhoeffer's work, apart from its intrinsic value, is of considerable importance in that it is likely to attract more general attention to the many contributions to chemical theory which have already been made by the new mechanics.

AN association such as the British Broadcasting Corporation, which has a vast audience almost at its mercy, obviously stands in a very critical position. It speaks well for the judgment and sanity with which its affairs are managed that notwithstanding the frequent comment, not always favourable, which appears in the Press, the total volume of criticism is relatively small when the range of the Corporation's activities is taken into account. It must have occurred to many when listening-in first became almost universal a few years ago that the real danger lay, not in the possibilities that the programmes arranged for the public might be too frivolous in character, but rather that they might be too academic. An educational instrument of such unbounded possibilities was scarcely likely to escape the attention of the over eager enthusiast. This danger has been successfully avoided. The educational section of the Corporation, which is assisted by a subsidy from the Trustees of the Carnegie Foundation, has proceeded with admirable caution. Having due consideration for the weaker brethren, it has on the whole avoided at any rate the appearance of the academic and the abstruse by exercising a judicious selection in its choice of lecturers and in censoring their titles.

IT also stands to the credit of the educational section of the B.B.C. that it appreciates the fact that its work to be effective cannot stop at merely the provision of lectures. The formation of circles for discussion among listeners—a feature which every effort is being made to extend—and the provision of pamphlets dealing with the subject of each lecture, well illustrated and provided with select bibliographies and sets of questions on each lecture, ensure that the listener has at any rate an admirable apparatus for extending and deepening his knowledge of the subject. We welcome the opportunity of directing attention to the British Broadcasting Corporation's educational work which is afforded by the issue of the series of pamphlets covering the broadcast talks to schools for the coming autumn term. The programme of this series of talks is controlled by a Central Council for School Broadcasting which works through a sub-committee for each subject.

THE number of sub-committees dealing with school broadcasting has recently been enlarged, and in several subjects lectures are now to be given for the first time ; such, for example, is the geography course planned by Prof. H. J. Fleure on "Peoples of the World and their Homes", in which a number of travellers will speak of people with whom they are intimately acquainted. Among the lecturers are the Right Hon. W. Ormsby-Gore, Capt. Hilton Simpson, Mrs. Rishbeth (Kathleen Haddon), and Mr. E. B. Haddon, to name a few only. A history course will be given by Miss Rhoda Power, the first series of whose "Days of Old" will cover the Middle Ages. The pamphlet accompanying this course is in itself most illuminating, especially as regards its illustrations. Nature study also is new, the lecturer being Miss Clotilde von Wyss. This course aims especially at developing individual practical work. Sir Walford Davies initiates a course on music in his entirely original and entertaining manner. Finally, among the new courses is one on French designed specially for central schools by M. E. M. Stéphan, of University College, London. Special attention should be given to a course on "Rural Survey" and "Farming" by Miss Charlotte Simpson and Dr. B. A. Keen of Rothamsted, which aims at arousing interest in the problems of the countryside not only among children of rural schools but also among their elders. A series of "Readings and Talks for Secondary Schools" by various lecturers covers a wide field, ranging from the classics to current events and the principles of air navigation.

ON Sept. 11 the British Broadcasting Corporation and the Baird Television Development Company issued a statement about television broadcasting. The experimental broadcasting of Baird television outside programme hours will begin on Sept. 30. These transmissions will normally take place through London (2LO) from 11 A.M. to 11.30 A.M. daily, except on Saturday and Sunday. The object of the demonstrations is to give the Baird Company a wider opportunity than it has hitherto possessed for developing the possibilities of the Baird system of television. It will also enable the Company to extend its scope and improve the quality of the reproduction. In granting these experimental facilities, in which some of the public will doubtless desire to assist, neither the Postmaster-General nor the B.B.C. accepts any responsibility for the quality of the transmission or for the results obtained. We hope that these experiments will be successful and that television will soon take a permanent place in our everyday life. In particular, we shall be interested to know the breadth of the band of frequencies required in the ether ; the trend of invention seems to be in the direction of narrowing this band very appreciably.

SIR PHILIP DAWSON points out in the *Times* of Sept. 10 that the grouping of the railways some years ago had the effect of stopping several schemes for the electrification of railways in Great Britain which had been accepted by the companies. He mentions that so far back as 1922 the chairman of the Brighton Company stated that his experts and officers unanimously agreed that electrification was necessary if the traffic was to be held. He also added that if they were independent he would do it at once. Sir Philip hopes that when the Weir Committee reports, main line electrification will be begun at once. Main line electrification will not only help many of the railways but it will also materially reduce the cost of electricity to all the consumers supplied by the Central Electricity Board. There is no difficulty in obtaining evidence in support of main line electrification both from America and Europe. In the same issue of the *Times* an ingenious argument is used against electrification. It is pointed out that with electric traction 30 to 50 tons of coal will be used in place of every 100 used with steam traction. The railways use more than thirteen million tons of coal annually. Hence any decrease in this consumption would affect materially an industry on the prosperity of which the railway companies so largely depend. The validity of this argument in favour of extravagance seems to us very doubtful.

AN Optical Congress, organised by the editor of the *Optician* to commemorate the three-hundredth anniversary of the granting of a Royal Charter to the Worshipful Company of Spectacle Makers, was held at the Northampton Polytechnic Institute, London, E.C.1, on Sept. 10–12. The Congress reflected all phases of activity in the sphere of ophthalmic optics and directed attention to undoubted progress during the last decade in the technique of eye examination and the production of spectacle lenses and frames and ophthalmic testing instruments. Papers on subjects dealing with the theory and practice of ocular examination were read, and the discussions showed a growing interest on the part of opticians in the scientific aspects of their work. Great interest was shown in a particularly fine display of historical literature and ophthalmic instruments arranged by the Applied Optics Department of the Northampton Polytechnic Institute, the original charter and by-laws of the Spectacle Makers' Company having been loaned for this exhibit. The technique of such instruments as the corneal microscope, stereoscopic fixation device, muscle-testing appliances, recent ophthalmoscopes,

etc., were demonstrated on living subjects by the inventors or originators of the methods. The appliances on view on the stands of the well-arranged trade exhibition illustrated the efforts that manufacturers are making to support the recent developments in sight-testing methods. There is a tendency, if anything, however, to employ old methods of treatment in new guise and to be somewhat precipitate in establishing them in practice. It would be an advantage if they were now subjected to close theoretical and experimental investigation. Nevertheless, the Congress afforded abundant evidence of definite progress in all branches of the optician's work.

FOLLOWING up the successful defence of the Schneider trophy, the same British seaplane (Supermarine Rolls-Royce), piloted by Squadron-Leader Orlebar, has established a new world's record over a straight 3 km. course of 575 km./hr., or 360 miles an hour, an increase of about 65 km./hr. over the previous Italian record. This is about half the speed of sound. We may agree with M. Blériot in his praise of aeroplane and engine, for indeed the smooth running of the latter and the steady, perfectly controlled flight of the former show that they are not mere freaks, but examples of sound engineering design and construction, which promise even better things in the future. But his suggestion that the speed of sound will be exceeded is not to be taken seriously at present. Apart from the difficulties imposed by a landing speed of about one-third of the flying speed, it appears from our limited knowledge that the drag of an aircraft increases enormously near the speed of sound, while the aerodynamical circulation round wings and air screw blades, and with them the lift and traction, fall off completely at the same time; so that flight as we understand it at present is deprived of its physical basis. Even before the limit is approached, we must expect something like the law of diminishing returns to apply, rendering each successive advance more and more costly in proportion to its magnitude.

THE severe earthquake in New Zealand on June 17 is being investigated very thoroughly by several government departments, and a provisional report has been issued by the Acting-Director of the New Zealand Geological Survey. Seismographs have been erected at Murchison and Westport in the hope of determining the epicentres and the depth of the foci of the after-shocks. Two geologists have already spent some time in the central district and further investigations will be made during next summer. Observations have been repeated from one of the Wellington City triangulation stations, and these will probably be made periodically. In addition to the renewal of the levelling from Glenhope down the Buller Gorge, bench marks have been placed on each side of the active White Creek fault, which appears to have allowed movements of earth-blocks to take place since the earthquake. Soundings have also been made off the west coast by the Marine Department. The principal results so far obtained are as follows. The centres of the main earthquake of June 17 and of the severe after-shock of June 23 seem to have been on the White Creek fault-plane that crosses the Buller River seven miles west of Murchison. Possibly a second centre was on the Kongahu fault-plane off the north-west coast of the South Island. Differential displacement of the order of 14 feet has taken place at the White Creek fault, though it is not yet known whether it took place suddenly or gradually, nor is it yet certain that the movement has ceased. On the west coast, at Whitecliffs, a strip of sea-bottom has been uplifted and now forms a ridge about a quarter of a mile long and 60 yards wide. It appears to be the western side of a small fault-block that is tilted eastward away from the Kongahu fault.

IN a speech in July last to the Sheep Breeders' Association of Australia, the Prime Minister of the Commonwealth emphasised the need for scientific investigations into problems facing Australian pastoralists to-day and handicapping them in both wool and meat production in competition against other countries. He stated that the Government is prepared to go a long way, through the Council for Scientific and Industrial Research, to meet the cost of the needed research work, but in its present serious financial difficulties it could not do everything. He invited the pastoralists to provide the main immediate need, which is a central building to house the Council's veterinary workers. Within a few weeks, Mr. F. D. McMaster, a leading stock-owner of New South Wales, offered to place £20,000 at the disposal of the Council for the erection of an Animal Health Laboratory. This generous offer was immediately accepted, and its acceptance carries with it an obligation on the part of the Council for Scientific and Industrial Research to equip, staff, and conduct the laboratory. In all probability the Council will seek the co-operation of the University of Sydney in establishing a Division of Animal Health, and the new laboratory will, in that case, be erected in the University grounds.

AT the sixth Pan-American Conference held at Havana in February last, it was resolved to establish an Inter-American Institute of Geographical Science. Mexico City was chosen as its permanent seat. A recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., announces that in furtherance of this scheme the Mexican Government is calling all American States to a geographical congress to be held in Mexico City on Sept. 18. The aim of the new organisation, which will eventually be housed in the suburb of Tacubaya, on a hill overlooking the city, is the co-ordination and distribution of geographical knowledge of the Americas. It will initiate and facilitate research and issue a series of publications. A library and map collection relating to American countries will be formed. The purpose of the present meeting is to complete the organisation of the Institute, to select its committee of control, and to fix the quotas that each State is to pay. Señor P. C. Sanchez will preside.

MORE than once reference has been made in these columns to the attractive way in which American scientific institutions display their wares to the public, partly for the sake of popular education, partly for the reflex interest which flows from an educated

public towards the institution and its works. Field exploration is an indispensable tool in the hands of the scientific worker, and the great part which it plays in the discovery of new knowledge may be guessed from the summaries of the year's expeditions in the "Explorations and Field Work of the Smithsonian Institution in 1928". This summary of 198 pages deals in a simple way (the scientific results will appear later in technical journals) with 29 expeditions, sent to the ends of the earth for a multitude of scientific purposes, from studying the heavens to studying the prehistoric Eskimo in Alaska, the Indian in Canada and the United States, shells in Cuba, grasses in Newfoundland and Labrador, and so on. It is a useful and, perhaps more to the point, an interesting summary, made vivid by a lavish use of reproductions of photographs.

THE August issue of the *Journal of the Franklin Institute* contains a 70-page report of the work done at the Bartol Research Foundation during the session 1928–29 under the direction of Dr. W. F. G. Swann. Four of the investigations mentioned relate to the detection and properties of radiations of cosmic origin, and three to the effects of the bombardment of atoms by electrons or by other atoms. Two deal with the behaviour of thin films towards incident light or electrons, and others with the nature of the processes associated with the emission of light from the electric arc, the reflection of atoms from crystals, and the relations between physics and vital processes. Progress in each of these investigations has been made, and the Foundation is thoroughly justifying its existence.

DURING the forthcoming winter Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff will be available for giving lectures to chambers of agriculture and horticulture, farmers' clubs, agricultural societies, etc., on the Rothamsted experiments. Communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

A GENERAL discussion, arranged by the Faraday Society, on "Molecular Spectra and Molecular Structure", will be held in the Department of Physics of the University of Bristol on Sept. 24 and 25, under the chairmanship of Prof. T. M. Lowry. The proceedings will be in three parts, dealing respectively with band spectra in the visible and ultra-violet, the Raman effect and infra-red spectra, and papers have been promised by many distinguished scientific workers. Among the well-known foreign workers taking part are Dr. H. A. Deslandres, Profs. R. T. Birge, R. S. Mulliken, F. Hund, V. Henri, E. Hulthén, Sir C. V. Raman, R. W. Wood, J. C. McLennan, and J. Cabannes. This discussion promises to rank high among the symposia arranged by the Faraday Society.

THE Carnegie Institution of Washington celebrated the twenty-fifth anniversary of the inauguration of research activities on board the ship *Carnegie* at San Francisco on Aug. 27 and 28. The commemoration referred generally to all the research work of the Institution, but more specifically to the investigations in terrestrial magnetism, atmospheric electricity, and oceanography. An exhibit of instruments was arranged on the *Carnegie*, which is in course of completing her seventh long cruise through the oceans of the world. The present cruise began in 1928 and is to end in 1931.

THE following appointments have recently been made by the Secretary of State for the Colonies, in the Colonial agricultural services: Dr. J. D. Tothill, superintendent of agriculture, Fiji, to be director of agriculture, Uganda; Mr. A. C. Barnes, assistant director of agriculture, Zanzibar, to be superintendent of agriculture, Fiji; Mr. H. Macluskie, to be agricultural superintendent, British Guiana; Mr. F. C. Cooke, to be assistant chemist for copra investigations, Federated Malay States; Mr. R. G. H. Wilshaw, to be assistant agricultural chemist, Federated Malay States; Mr. A. G. Turner, to be citrus specialist, Palestine; Mr. W. B. Hutchinson and Mr. R. D. Linton, to be district agricultural officers, Tanganyika Territory; and Mr. C. H. Clifford, to be a produce inspector, Nigeria.

THE retirement of Prof. F. W. Oliver from the Quain chair of botany at University College, London, was made the occasion of an appeal for funds to commemorate the sixty-nine years' association of Prof. Oliver and of his father, Prof. Daniel Oliver, with the chair of botany at University College. The appeal resulted in the collection of a sufficient sum of money to enable the committee to found an Oliver Commemoration Bursary of the annual value of about £20 for the purpose of assisting graduate students of University College to prosecute research in botany. At a dinner given to Prof. Oliver at University College on July 3 last, under the chairmanship of Prof. F. O. Bower, the Committee's decision with regard to the disposal of the funds was announced and a cheque for his personal use, together with an album of the autograph signatures of the contributors to the Fund, were presented to Prof. Oliver.

APPLICATIONS are invited by the Director of Agriculture, Punjab, for the Maynard Ganga Ram Prize, the value of which is 3000 rupees, for a new practical method tending to increase agricultural production in the Punjab on a paying basis. The prize is open to all. Applications must reach the Director of Agriculture, Punjab, Lahore, on or before Dec. 31 next.

THE *Natural History Magazine* for July contains a short, illustrated account of some aspects of the work of the Great Barrier Reef Expedition of 1928–29, by Geoffrey Tandy, of the British Museum (Natural History), who worked for some time as botanist to the Expedition.

THE nineteenth meeting of the Australasian Association for the Advancement of Science was held at Hobart in January 1928, and the Report has recently been published by the Association (5 Elizabeth Street, Sydney, N.S.W.). The volume contains the usual information relating to officers and statutes of the Association, the presidential address delivered by the

late Mr. R. H. Cambage (referred to in NATURE of Feb. 11, 1928, p. 225, and April 7, 1928, p. 554), the reports of research committees, addresses delivered by presidents of sections, and abstracts of papers read. There is a subject and author index.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A resident tutor and lecturer in geography at St. John's College, York—The Principal, St. John's College, York (Sept. 24). Two mechanical engineers, technical assistants, at the Royal Arsenal, Woolwich—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E.18 (Sept. 28). An engineering inspector under the Minister of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Sept. 28). A curator-secretary for the Victoria Memorial Hall, Calcutta—Sir Evan Cotton, 14 Craven Hill Gardens, W.2 (Sept. 30). An instructor in commercial fruit growing under the Kent Education Committee—The Agricultural Organiser, Springfield, Maidstone (Sept. 30). A full-time lecturer in pure and applied chemistry at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Sept. 30). The William Julius Mickle Fellowship of the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 30). An assistant pathologist and research fellow in the Pathological Department of the Hospital for Sick Children, Great Ormond Street—The Secretary, Hospital for Sick Children, Great Ormond Street, W.C.1 (Sept. 30). A demonstrator in electrical engineering in the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, South Kensington, S.W.7 (Oct. 1). An assistant for mathematics and physics at the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Oct. 1). An assistant examiner in the Standards Department of the Board of Trade—The Principal Establishment Officer, Board of Trade, Great George Street, Westminster, S.W.1 (Oct. 2). A technical officer at the Royal Aircraft Establishment for writing technical descriptive matter and instructional handbooks on aircraft, aero-engines, and accessories—A. 371, The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 2). An agricultural and horticultural organiser under the Bedfordshire County Council—The Clerk of the County Council, Shire Hall, Bedford (Oct. 5). An instructor in smithing and sheetmetal work at the Government Technical School, Makerere, Uganda—C.A. (T.), The Secretary, Board of Education, Whitehall, S.W.1. Scottish candidates should apply to (T), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Oct. 7). A principal of the L.C.C. Paddington Technical Institute—The Education Officer (TIA), County Hall, Westminster Bridge, S.E.1 (Oct. 7). An assistant anatomist in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Oct. 8). A Mary Louisa Prentice Montgomery lecturer in ophthalmology of the School of Physic, Trinity College, Dublin—The Registrar, School of Physic, Trinity College, Dublin (Nov. 1). A physiological botanist at a Sugar Research Station in Mauritius—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 15). A full-time lecturer in physics at the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland. Two assistants in the Motor Car Engineering Laboratory of the Polytechnic School of Engineering—The Director of Education, The Polytechnic, Regent Street, W.1.

Our Astronomical Column.

Attempts to photograph the Corona without an Eclipse.—A. Hnatek contributes a note to *Astr. Nach.*, 5652, in which he refers to the attempts of Herr Blunck to photograph the corona in full sunlight by the use of plates sensitised for infra-red light, and special light-filters. Herren Kienle and Siedentopf afterwards gave reasons to doubt whether the images obtained by Herr Blunck were really coronal : A. Hnatek agrees with Kienle and Siedentopf in considering the images spurious. He describes some experiments of his own which gave markings resembling the corona round the sun, but their coronal nature was afterwards disproved. He thinks that coronal photography in daylight would be feasible only on the supposition that the coronal light was relatively much stronger in the infra-red than ordinary sunlight ; he gives reasons for thinking that such is not the case. It would seem to be a safe precaution that those claiming to have taken such photographs should take photographs at times when the moon is just outside the sun's disc. Failure to show the moon's outline at such times would definitely disprove the coronal origin of any markings visible on the plates.

Bergedorf Observatory.—The annual report of this Observatory for 1928 contains a record of much useful work. In connexion with the photographic reobservation of the stars in the zones of the Astronomische Gesellschaft catalogue, the Observatory has undertaken the meridian observation of the 13760 reference stars, and the photography of the zones between 20° and 70° North Declination. The publications of the Observatory contain discussions on the theory of instruments, the Cepheid variables, the Schwassmann-Wachmann Nova of 1927, etc. ; a catalogue of 4983 stars observed on the meridian between 1913 and 1926 ; the useful reference volumes containing indices of meridian observations of stars.

Dr. Baade exposed 241 plates in the reflecting telescope, on comets, minor planets, variable stars, clusters, and nebulæ. Prof. Schwassmann and Dr. Wachmann used the Lippert astrograph for photography of the Kapteyn selected areas, including spectrum plates : the spectra of meteors were photographed and discussed.

The report contains reproductions of photographs of the full moon and Jupiter ; the latter bring out the great contrast in albedo between a bright zone south of the equator and a dark one to the north.

The report also gives summaries of meteorological observations during 1928 : the months March and September gave an unusual number of clear nights. The Observatory is open to visitors twice a week in the summer : some two thousand people availed themselves of this permission last year.

Research Items.

English Gypsy Taboos.—In the *Journal of the Gypsy Lore Society*, sec. 3, vol. 8, pt. 1, Mr. T. W. Thompson has some notes of gypsy uncleanness taboos additional to those published by him in 1922, which were observed by the Midland Boswells. The Locks of Bala were found to be almost as particular as the Boswells. Food and food vessels over which a woman stepped were destroyed, men's and women's clothes were not washed together, or packed together for travelling. The handling of red meat was forbidden to women at all times. Menses might not be mentioned, even to a husband. At childbirth a woman had a separate tent and separate crockery. The latter was afterwards destroyed but the tent blanket was not. A period of a week's seclusion preceded the birth, and the mother did not live with the family for a month after the event. After this period she might cook for the family once more. Among gypsies of Lee extraction, any food in which a hair was found was regarded as unfit to eat and was thrown away, while some gypsies would not eat from a plate that had touched the trodden ground of a camping-place or the floor of a tent or living waggon. Among Boswell women it was a belief that if they let down their hair it would facilitate delivery at childbirth. Hence a rule that a woman must not let down her hair where men were, or indeed anywhere but in her own hut unless she were sure that only women were about. All babies under a year old were regarded as unclean, and some gypsies would not sit down at a meal with or accept food from a couple who had very young children, while some men would not kiss or even touch their own babies. Boswells would not eat the flesh of any unweaned animal. Also, like German gypsies, they regarded a knife which had been used for slaying a horse as unclean.

The Navajo.—In a monograph recently published by Columbia University (*Contributions to Anthropology*, vol. 7) on the social life of the Navajo—a subject which appears hitherto to have escaped investigation on scientific lines—the author, Miss Gladys A. Reichard, has some amusing observations to make upon the difficulties which stand in the way when the United States authorities have endeavoured to make a census of the population. One of the difficulties is the frequent change both of residence and of name. Hence one individual with his family may be noted; a week later he may be living fifty miles away under a different name, and again be noted by a recording officer. In her own work, Miss Reichard used the genealogical method, and it was often only after elaborate study that she was able to identify two or more names as referring to the one individual. Owing to the difficulties of the Navajo country (New Mexico and Arizona), some regions have not yet been penetrated by whites, and it is said that there are Indians living around Black Mountain who have never seen a white. The genealogical method employed by Miss Reichard in her field work may throw a valuable light on their history, but until the uncharted fields mentioned by her have been visited, the question of the extinction of certain clans of which she has found a record cannot be settled, as localisation seems to have taken place. The Navajos are perhaps best known for the skill of the men as silversmiths, and of the women as weavers of blankets. Their artistic sense, however, finds highest expression in the making of sand or dry paintings—a man's art. Unfortunately, if æsthetically the most pleasing, it is also the most evanescent.

Trawling in the Moray Firth.—A detailed report of the Committee appointed by the International Council for the Exploration of the Sea to consider this vexing question has recently appeared (*Rapports et Procès-Verbaux des Réunions*, vol. 52). The terms of reference to this Committee were arranged as follows: "To inquire as to the effects of trawling in the Moray Firth in the light of the scientific investigations already carried out or of any further investigations which the Committee may deem necessary, or of any other relevant considerations, and to consider particularly whether it is desirable to continue the existing prohibition of trawling there, and whether the prohibition in its present or any modified form should be applied to any other method of fishing and to fishing vessels of all nationalities in the whole or any part of the extra-territorial waters of the Firth". In its report the Committee makes a definite suggestion for the experimental closure of some part of the Moray Firth, with the view of protecting spawning plaice. The proposal entails the exclusion of trawlers and seiners from that part during a period of each year. Twelve papers dealing with the various aspects of the general question are appended.

***Halosphæra* in the North Sea.**—C. H. Ostenfeld brings together notes by himself and other workers on the pelagic alga *Halosphæra* in *Dansk. Bot. Arkiv.*, Bd. 5, No. 8, 1928. His observations were made in the North Sea and certain parts of the North Atlantic. In the spring the species found was *H. viridis*, but in the autumn a much smaller form, *H. minor*, occurred. He considers that *Halosphæra* belongs to the large group of warm-temperate and subtropical plankton organisms which are driven far north and eastwards by the North Atlantic Drift. It has exceptional powers of floating and its cell wall, which in *H. viridis* contains silica, enables it to resist changes in external conditions. The author believes that most of the individuals die in the winter, that in the spring the remaining examples produce the maximum and end by forming zoospores, but the latter do not succeed in producing a new generation in the North Sea. In this he differs from Gran, who stated that *H. viridis* goes through its whole life-cycle in the Norwegian sea in the course of a year. Ostenfeld places the genus in the Heterokontæ—not in the Chlorophyceæ—and Pascher agreed with this view.

Growth of a Pond Snail.—E. D. Crabb, having developed a method of rearing pond snails in the laboratory for experimental purposes, using *Limnæa stagnalis appressa* for the purpose (*Biol. Bull.*, vol. 56), proceeded to make experiments by varying the conditions of food and media from the optimum with the view of testing the results obtained by previous workers, including Semper. His principal conclusions are as follows: Food insufficiency and foul media are the most common growth-inhibiting factors; extreme crowding retards growth, but individuals, if not too old, rapidly reach the norm on being isolated; the volume of medium has little effect if foulness be avoided; there is no evidence that dwarfing produced by unfavourable culture conditions is transmitted.

Aspergillosis.—Investigators interested in aspergillosis should consult the memoir (1928) on *Aspergillus fumigatus* by Dr. Vittorio Pettinari which has been awarded the Cagnola Prize by the Reale Istituto Lombardo di Scienze e Lettere. This species of *Aspergillus* is highly pathogenic to the guinea-pig, rabbit, dog, cat, rat, pigeon, and fowl when introduced intravenously, intraperitoneally, or into the trachea, but cold-blooded animals—frog and fishes—are refractory. The fluid from cultures has a strong hæmolytic action

in vitro and the hæmolytic substance is thermostable and cannot be extracted with ether, but it does not exercise a demonstrable toxic action when introduced into the common mammals. In acute infections there is rapid emaciation, paresis, and death in a few days. The introduction of a suspension of spores intravenously may cause mycotic nodules in nearly all the organs and tissues, or a localised infection for the most part in the kidneys. The localisation depends not only on the mode of introduction but also on individual conditions. In the normal animal infected with *Aspergillus*, the latter exercises a strong hæmolytic action. An account is given of the immunisation of dogs; the immunity lasts at least a year.

Genetical Studies at Cold Spring Harbor.—Year Book No. 27 of the Carnegie Institution of Washington contains a condensed account of the genetical investigations which are being carried on in connexion with that Institution at Cold Spring Harbor. Among the subjects in which further developments are reported may be mentioned Belling's studies of chromomeres by a new method. He found the number of chromomeres in the pachynema thread of *Aloe purpurascens* to be 1240 and he believes they correspond with the genes. In *Datura*, Blakeslee has found several new Mendelian characters and has obtained further evidence that in certain races with linked chromosomes there has been an interchange of segments between non-homologous chromosomes, resulting usually in the formation of a ring or chain of four chromosomes. Experiments of Demerec in producing mutations in *Drosophila* by X-ray treatment, and of similar treatment of pollen and pollen tubes by Buchholz, are also reported. Miss Satin finds that in the bread moulds the female or plus mycelium has a higher sugar content than the male. In ringdoves, Riddle finds that females have 5-10 per cent longer intestines and larger pituitaries than males; also that there is a seasonal increase in the size of liver and spleen in both sexes during spring and summer. In the biological section, Castle reports on a continuation of his investigations of size-inheritance in rabbits, and Harris on fecundity in fowls and various other biometric problems. Sumner has made an intensive study of the differentiation of certain native varieties of *Peromyscus* in Alabama, and Morgan and his colleagues report on their continuation of the *Drosophila* work. In a strain with frequent non-disjunction of the *X*-chromosome, it is found that this rate is modifiable by agencies in other chromosomes. There is a relation between non-disjunction and suppressors of crossing-over, and it is suggested that translocation of a portion of a chromosome has taken place, so that homologous parts are no longer opposite each other.

Competent or Incompetent Folding?—Despite H. G. Busk's recent exposition of the anticline and syncline in all their aspects, and notwithstanding the claim that geometrical conics may make to their interpretation, there still remain many cases in which the inexactitude of geology is glaringly apparent, when surface evidence conflicts with subsurface conditions to the extent of making one an unreliable guide to the other. The Rock Creek oilfield, Wyoming, described by Messrs. C. E. Dobbin, H. W. Hoots, C. H. Dane, and E. T. Hancock (*Bulletin* 806-D, 1929, United States Geological Survey), provides an excellent example of this in the Medicine Bow Anticline, one of the dominant structures mapped. The sequence involved is Cretaceous, of which the top of the Cloverly formation, Wall Creek Sandstone and Mesaverde formation, are the chief members (with intervening shales), the latter being the youngest. Two interpretations of the structure are possible in view of the data collected. The Cloverly and Wall Creek beds are either folded parallel with the Mesaverde (competent), in which case the anticlinal axis shifts considerably in position with depth (that is, westward); or they are 'similarly' folded with the Mesaverde (incompetent), in which case the productive beds are attenuated on the steeper limb of the fold (eastward) and the trace of the axial plane remains vertical. In view of the types of rock involved, it is probable that the second suggestion is the correct one. The example shows (*a*) how difficult it is in many cases to anticipate, let alone follow, the trend of a fold in depth, and (*b*) what a difference an erroneous interpretation, based on what ought to, rather than what does happen, can make to the economic exploitation of an oil-pool.

New Eocene Crab from Florida.—Miss Mary J. Rathbun has described a new crab from the Eocene Series of Florida (*Proc. U. S. Nat. Mus.*, vol. 75, art. 15). *Ocalina*, as the new genus is called, is nearest to the recent genus *Carpilius* Leach, of which one species is not uncommon in the West Indies and the Bahamas; the specific name *floridana* has been given to the new form, which is illustrated on three plates.

New Zealand Tertiary Mollusca.—Dr. J. Marwick has published a description of the molluscan fauna of Chatton, near Gore, Southland, New Zealand (*Trans. New Zealand Inst.*, vol. 59). Accurate correlation of the Chatton Sands with other fossiliferous deposits of New Zealand is difficult; the assemblage of genera, however, agrees much more closely with that of the Middle Tertiary faunas (Ototaran to Awamoan) than with early Tertiary ones, and probably belongs to the Ototaran. Altogether 77 species are described, including 44 claimed as new, whilst two new genera are established. Illustrations by very clear line drawings of the new species occupy the last eight pages of the paper.

Physical Constants.—The first number of the *Physical Review Supplement*, the new quarterly publication of the American Physical Society, contains a valuable critical summary of the probable values of the general physical constants, by Prof. R. T. Birge. These have been recalculated, wherever it seemed necessary, by analytical methods, usually by the method of least squares, and the probable errors have also been computed wherever possible. The results have been grouped under three heads, principal constants and ratios, additional quantities closely connected with these, and miscellaneous derived constants, and the tables have also been published separately in the form of handy reference cards. It is impossible to refer here to the many interesting points that are raised by Prof. Birge's article, which really summarises a great part of experimental physics, but there are two discrepancies which are of special importance. The first is in the values for the specific charge of the electron (e/m). This can be determined by deflection experiments and spectroscopically, and there is a difference between the numbers found in these two ways which is four times the probable error of the former, and apparently real. The deflection value is the larger, or, in other words, e/m appears to be less for an electron when it is *inside* an atom than when it is *outside*. The other discrepancy is that existing between the theoretical and experimental values for Eddington's constant, and Prof. Birge is unable to trace definitely the origin of this; the present impasse is, as he points out, a most unsatisfactory way to leave the situation in the case of the most important constants known to science.

New Ester Synthesis.—The important position which acetoacetic and malonic esters occupy in synthetic organic chemistry make a new synthesis of these compounds worthy of note. Such a synthesis is described in the July number of the *Berichte* (vol. 62, p. 1824) by Hermann Lux, of Karlsruhe, who uses as reagent the ester of the simplest organic dibasic acid, namely, ethyl carbonate. This compound is treated in ether with finely divided metallic sodium, and acetone is slowly dropped into the liquid, which is kept vigorously boiling. Acidification of the cooled product, followed by fractionation, gives a 40 per cent yield of acetoacetic ester. Malonic ester is prepared in a similar way, replacing acetone in the reaction mixture by ethyl acetate; an 18 per cent yield is obtained. It is proposed to extend the new synthesis to higher esters; if it is successful with these, it should be a valuable new method in chemical synthesis.

Synthesis of Hæmin.—Hæmoglobin, the red colouring matter of blood corpuscles, consists of about 4 per cent of a pigment, hæmatin, supposed to be the same in all corpuscles, with 96 per cent of a protein, which is different in different animals. The empirical formula of hæmatin is $C_{34}H_{33}N_4FeO_5$, and it is the carrier of oxygen in respiratory exchange. By the action of glacial acetic acid on hæmoglobin, the coloured hæmatin is formed, whilst if sodium chloride is present a hydroxyl group of hæmatin is replaced by chlorine, and hæmin, $C_{34}H_{32}N_4O_4FeCl$, is produced. Hæmin forms characteristic microscopic reddish-brown crystals, and its production is used in the identification of blood. In the issue of *Die Naturwissenschaften* for Aug. 2, H. Fischer, of the Technical High School, Munich, describes the synthesis of hæmin. This closes a series of researches on the synthesis of pyrrol derivatives: the synthesis begins with 4, 5 dimethylpyrrol, which by a series of reactions was converted into deuteroporphyrin. A further series of reactions led to hæmatoporphyrin, a product free from iron which is obtained by the action of hydrobromic acid on hæmin. On heating, this loses two molecules of water, giving protoporphyrin, into which iron and chlorine were introduced, giving hæmin. The constitutional formula of this substance was thus established. Roughly speaking, it consists of a rosette of four substituted pyrrol rings linked together by CH groups, and of the four nitrogen atoms in the centre, two are directly linked to FeCl, the other two being linked by subsidiary valencies to this group. It contains two COOH groups and two vinyl groups.

Nitrogen Distribution of Gelatin.—Within the past few years, several publications have appeared from the Biochemical Department of the Imperial College of Science, London, on the effect of certain preliminary treatments of the protein on the nitrogen distribution of gelatin. For example, it has been stated that if gelatin is allowed to stand at laboratory temperature with 20 per cent hydrochloric acid, before hydrolysis proper, a marked increase in the percentage of basic nitrogen (that present in compounds precipitated, under defined conditions, by phosphotungstic acid) occurs. Some of the results from the same laboratory are inconsistent, and in view of the importance of the data the experiments have been repeated and extended by F. S. Daft in Prof. Sörensen's laboratory at Carlsberg. The results obtained fail to substantiate the principal contention of the Imperial College workers, since they show no change in nitrogen distribution due to preliminary treatment of gelatin with acid or alkali. They appear in No. 12 of vol. 17 of the *Comptes-rendus des travaux du Laboratoire Carlsberg*, 1929. No. 14 of the same volume contains a long and important paper by Prof. Sörensen and I. Sladek on the solubility of casein in sodium hydroxide. As in the case of globulin (investigated by Hardy and Mellanby), increasing quantities of casein, with constant sodium chloride concentration and constant amount of sodium hydroxide, result in the solution of greater quantities of casein. No. 9, by Linderström-Lang, is a long memoir on the fractionation of casein, in which it is shown that this protein is complex.

Persian Alchemy.—In a recent number of the *Memoirs of the Asiatic Society of Bengal* (vol. 8, No. 7, pp. 419-460; 1929), Mr. Maqbul Ahmad describes a Persian translation of the eleventh century Arabic alchemical treatise "Essence of the Art and Aid to the Workers" (*'Ain aṣ-Ṣan'ah wa 'Aun aṣ-Ṣana'ah*), a work which is attributed to Muhammad al-Kathi and is supposed to have been written at Baghdad in 426 A.H. (A.D. 1034). The Arabic version was described by Stapleton and Azo in 1905, from an incomplete manuscript in the library of the Nawwab of Rampur. The Persian translation was discovered by Stapleton in 1925 in the library of the Nizam of Hyderabad, and has now been studied by Mr. Ahmad, while Prof. B. B. Datta contributes a useful note on the chemistry of the processes given in the treatise. The importance of the Persian version lies in its rendering of the seventh chapter, which is almost completely missing from the Arabic original. The first part of this chapter describes four major operations by which copper was supposed to be changed into silver, but was actually converted into (*a*) an alloy of silver and copper, (*b*) a white fusible sulpho-arsenide of copper, (*c*) a white arsenide of copper, and (*d*) an amalgam. Among the substances employed, it has been possible to identify solutions of sodium polysulphide, sulphuretted hydrogen, and basic arsenosulphide of lead and calcium, as well as the following solids: mercuric chloride, ferric acetate and impure mercuric oxide, realgar, cuprous oxide and ferric oxide. The sixth chapter, which also is not found in the Arabic, deals with the substitution of one instrument or substance for others where circumstances necessitated such a course; it is interesting as an indication of the difficulty frequently experienced by the alchemists in obtaining suitable apparatus. Among the authorities mentioned in the treatise are Andriyya the Sage, Moses, Khalid ibn Yazid, and Sa'd ad-din; nothing is known of the last, while Khalid is described wrongly as one of the Barmecides.

Mercury Arc Rectifiers.—Instead of using rotating machinery to convert alternating into direct current for use on railways and tramways, it is now becoming customary abroad to use mercury arc rectifiers. They have the advantage of being static and require very little floor space. We learn from the June number of the *Oerlikon Bulletin* that the Oerlikon Company has now evolved rectifier types and carried out tests in its workshops for equipments with capacities up to 2500 kilowatts which operate at 1500 volts. The Company is constructing for the Bernese Oberland Railway rectifiers which will work at 1550 volts. These rectifiers are put into operation by a simple switch. A pilot lamp is provided which shows whether the ignition device is working properly. The direct reading vacuum meter is based on the principle that in a vacuum tube the cathode drop depends on the degree of the vacuum. The pressure variations are read on a static voltmeter connected to the terminals of the tube. The readings give the pressure directly in millimetres of mercury. The cooling of the rectifier is generally done by means of water which circulates in a closed circuit. All the transformers are built so as to withstand short circuits.

The Treatment of Slash in Chir Pine Forests in the North-west Himalaya.

THAT fire is more dangerous to the well-being of coniferous than broad-leaved forests, and more especially in the young crops, is beyond dispute. Climatic factors and topographical features may, however, add very considerably to the danger. Hot, dry periods of the year, steep declivities, and the species of conifer comprising the crop, have all an important bearing on the question. To take a European example, the maritime pine forests of the Landes in France are exceedingly inflammable during the hot summer months, and their protection from fire entails considerable work and a heavy responsibility on the forest staff. The tree is tapped for resin, a factor adding greatly to the inflammable character of the forest, as is the case in the resin-tapped forests in America. In the Landes, however, the terrain is mostly approximately flat.

Perhaps one of the most inflammable types of forest in India is the Chir pine (*Pinus longifolia*) forests on the lower slopes of the north-western Himalaya. This long-leaved pine, as its name implies, has long needles, which often collect in thick, undecomposed deposits on the soil. The forest not uncommonly occupies undulating hilly ground with steep slopes and declivities, and is exposed every year for two or three months to a hot sun accompanied by hot winds. As in the case of the Landes and American forests, this pine is also tapped for resin. Serious fires have from time to time devastated the areas covered by the *chir* pine in Kumaon in the United Provinces, fires which may be said to have culminated with the insensate incendiarism of 1921, during which large areas of established young growth, established by the arduous work of the forest staff, were swept away. Such calamities necessitate a heavy expenditure, since the areas so affected, in the absence of all seed trees, can only be reclothed by artificial means, as the result of much careful work.

Mr. J. E. C. Turner, a Deputy Conservator of Forests, has had great experience of this type of forest in Kumaon and of the excessive harm resulting from fire. As a result of his study of the question he has drawn up a monograph entitled "Slash in Chir Pine Forests", which is published as Part VII. of Vol. 13 of the *Indian Forest Records* (Silviculture Series, 1928). To this monograph the Commissioner of Kumaon, Mr. N. C. Stiffe, has contributed a foreword, thereby emphasising the importance of the matter in this type of forest and his recognition of the difficulties experienced by the forest staff in protecting it from the acts of a population by no means enamoured of forest protection—for of true forest conservation they know little or nothing. "The subject", writes the Commissioner, "is really too technical for the amateur, but its importance cannot be missed by any one who has traversed any considerable area of the Kumaon forests."

It will be remembered that a notice was given in NATURE of April 14, 1928, under the title "Injury by Fire and Bark-beetle Attack", to two small monographs published in the United States dealing with the relation of fire injury to insect attacks in coniferous forests (Western yellow pine), and such attacks in connexion with the slash left over after exploitation has been carried out. Although Mr. Turner is not primarily concerned with insects, the investigation work treated of in the American monographs merits consideration, when read in conjunction with the paper now under notice.

The author comprehensively defines slash as including all debris resulting from operations involving the felling and utilisation of *chir* trees, and also from the destruction of this species by such agencies as wind, snow, fire, lightning, floods, landslips, insects, and fungi. In addition to the above, he says, there will be present in *chir* forests, especially in the higher parts of the *chir* zone, slash resulting from broad-leaved species such as *Quercus incana*, *Rhododendron arboreum*, *Pieris ovalifolia*, and other associates of less importance. He rightly insists—a point not usually given sufficient attention—that the treatment of slash is an integral part of the practice of sylviculture, and more especially is this the case in forests susceptible to severe damage by fire.

"There is abundant evidence to show that the subject of slash disposal has not received sufficient attention in the past, and that its sylvicultural importance has not been adequately appreciated. . . . It is necessary to realise that the prompt treatment of slash is a preparatory and essential measure towards the successful and rapid natural regeneration of areas allotted to the first periodic block; and that it clearly behoves us in future to consider slash disposal in a systematic and generous manner, so that the operation shall automatically and quickly follow exploitation."

Briefly, the author's aim is to lay down definite and constructive suggestions in order to attain so far as possible the complete natural regeneration of given areas in a given time; and to indicate how the fire danger in the intermediate and last periodic blocks can be reduced to a minimum, and thereafter maintained in that condition.

The main factors governing the quality and size of slash on an area depend upon the extent of utilisation of the material (that is, the trees) and on local conditions. Mr. Turner treats of the former in great detail; the second, the local conditions, is complicated in Kumaon by the necessity of making provision for right-holders amongst the villagers. When the village population is dense, and the right-holders' demand for firewood consequently large, slash is removed in a relatively short time. If, however, a locality is sparsely populated, the slash, unless removed by departmental action, will lie on the forest floor for a considerable period, which may extend to five years or more. The precise influence of local conditions on slash removal demands a close study on the part of the local forest officers. A knowledge of such conditions will dictate the extent to which departmental action is necessary, and will suggest the least amount of expenditure with which the work can be efficiently accomplished.

These remarks apply to artificially formed slash, the debris from felled trees. Natural causes such as wind, snow, avalanches, etc., may be responsible for heavy amounts of slash, which may include numbers of whole trees. When slash cannot be sold or absorbed by right-holders, for whom provision must be made in the Almora region, within a reasonable time, various methods of burning are resorted to, a difficult business requiring the greatest care. Limitations of space make it impossible to follow Mr. Turner in his discussion on the technique of burning and other points dealt with. The monograph, which is excellently illustrated, merits a close study by the forest officer, and it may be recommended, amongst others, to those responsible for the protection and management of the large areas of coniferous and other inflammable types of forest in Canada, the United States, and Australia, in all of which countries fire damage is so terribly prevalent.

Prehistoric Society of East Anglia.

RESEARCHES in East Anglia of considerable general importance were described at the summer meeting of the Prehistoric Society of East Anglia, held at the Royal Anthropological Institute in June last. The president, Mr. J. E. Sainty, of Norwich, gave an account of investigations undertaken by aid of the Sladen trust into the contents of the Stone bed beneath the Norwich Crag, the equivalent of the basement bed of the Red Crag in Suffolk. The conclusions were wholly in favour of the human origin of the flaking upon the flints, which, from the bold character of the work upon a hand-axe from Whitlingham, was considered to date from the Early Chellean period. It appears probable that there is little difference in geological age between the Norwich Crags and the deposits of the Cromer Forest bed.

Mr. J. Reid Moir showed black unrolled hand-axes of Combe Capelle, Early Mousterian type, which with numerous flakes and remains of mammoth and reindeer, and also fine Early Solutrean flint blades, were recovered from below thick deposits of gravel forming the flood plain of the River Gipping, near Ipswich. The Solutrean implements come from a clay at the base of the gravel which is here ten to eighteen feet thick, and the Early Mousterian hand-axes from a peaty loam beneath. In the Orwell estuary, the tidal part of the same valley, below Ipswich, peat occurs at a depth of thirty feet below high-water mark, and numerous teeth of the mammoth have been dredged from it. This peat is covered by gravel and grey alluvial mud, and may possibly be the equivalent of the peaty loam of the Early Mousterian horizon farther up the valley. It is seen, therefore, that a date much older than that usually assumed must be assigned to the greater part of the deposits filling the deep channels beneath the river valleys of the east of England, as the Neolithic layer appears to be only about four feet from the surface in the Orwell alluvium.

In the discussion, in which Messrs. R. A. Smith, H. Dewey, and Henry Bury took part, it was recalled that black unrolled hand-axes have been dredged up at Erith, which may indicate a horizon in the bed of the Thames equivalent to that in the buried channel of the Gipping. Another significant fact was that on the south coast the 'Coombe Rock' deposit is known to pass below sea-level. The new evidence was unexpected, and as it points to an order of events different from that assumed for the formation of the deposits of the lower Thames valley, it is important that investigations in that area should be commenced.

In reply, Mr. Moir stated that the trend of the evidence suggested to him that the buried channels beneath the river valleys of the east of England were excavated so early as the second interglacial period.

The discovery of thin ovate palæoliths in a clay deposit at Denham, Bucks, at 214 feet, O.D., and covered by gravel, hitherto classed and mapped as glacial, was reported by Mr. J. G. Marsden, and Mr. E. J. Guerrard Piffard exhibited microliths from the Horsham district showing a considerable amount of wear.

Scientific Utilisation of Coal.

THREE Cantor Lectures on the "Treatment of Coal" were delivered last winter before the Royal Society of Arts by Dr. C. H. Lander, Director of Fuel Research; these have been printed in the Society's *Journal* of Aug. 9, 16, and 23. The first lecture details steps taken in Great Britain to standardise methods of sampling and analysis—a task long overdue and of great importance to those engaged in buying and selling fuel and also in the testing of fuel-using appliances.

Recent work on the constitution of coal is surveyed and the problem of burning coal in large and small particles is subjected to a critical analysis. The combustion of gaseous fuel is so rapid that it is merely a question of bringing air and gas into intimate mixture. With solids, even the smallest solid particles in practice are gross compared with simple gaseous molecules, and the rate of supplying oxygen to the surface of the fuel becomes the dominating factor. A rapid velocity of air-flow relative to the coal is essential to facilitate the supply of oxygen and removal of products from the surface of the fuel. In modern practice this is attempted by the use of 'turbulent' burners.

Successful as this has been, Dr. Lander believes that it will be preferable to obtain a stable and streamline motion of air and induce the particles of fuel to move from one stream-line to another in controlled manner. By facilitating the supply of air to the coal dust, it has become possible to reduce the 'combustion volume' considerably until the properties of the refractories have become a limiting factor. It has also become possible to burn pulverised coal in the Scotch marine boiler, and Dr. Lander considers that eventually this will be done in the locomotive boiler.

The importance of these developments to the British coal industry is obvious. Encouraging results have been obtained with ships adapted to use pulverised fuel, and recently a new vessel, the *Berwindlea*, specially constructed for this purpose, made its first voyage, apparently with complete success.

In the second lecture, Dr. Lander traversed briefly the methods and results of chemical investigations of the structure and composition of coal, of which a great volume has been made in recent years. The replacement of cruder methods of fuel use by more refined treatment necessitates an investigation of these fundamentals.

So far as standard practice of carbonisation at high temperature is concerned, there is no prospect of any revolutionary improvements in efficiency, although advances in technique in recent years have been made which, reckoned on such large industries, amount in the aggregate to very considerable financial savings. The recent technical history of the gas and coke industries is traversed in an informative manner, and some indication is made of problems under investigation and of topical interest.

The third lecture deals with the attainments and prospects of processes of low temperature carbonisation. Much money has been squandered on this subject owing to the earlier methods of 'research by catastrophe'. More recently the extensive investigations of many serious workers have placed the subject on a more certain basis, and one can justifiably say that there are processes which are technically satisfactory. It is emphasised that the ultimate test, namely, whether the processes can produce dividends on invested capital, is not yet answered with certainty. In order to secure answers to these questions the Government has made technical trials of processes, cost free, and reports of these have been from time to time referred to in the columns of NATURE. In

addition, it has entered into an arrangement with the Gas Light and Coke Company, whereby the latter operates the Fuel Research Board process under commercial conditions at its Richmond works. The results are to be published, and should give a good idea of the commercial status of such processes.

Other processes which have reached a working scale in Great Britain were discussed by Dr. Lander. Experience with the process of coal hydrogenation was discussed, but the results do not suggest any immediate possibility of competing with mineral oil at present prices. A most interesting discovery is the possibility of converting a non-coking coal into a strongly coking product by the addition of less than 1 per cent of hydrogen.

Processes for the synthesis of fuels from water-gas do not seem to have any immediate commercial possibilities, although high-priced products such as methyl alcohol are already being made by such methods.

The three lectures give a concise amount of the scientific and technical work on the treatment of coal and the nature of the problems under investigation and awaiting solution in Great Britain.

H. J. H.

Ventilation.

IN a recent lecture before the London and South-Eastern Counties Section of the Institute of Chemistry, R. C. Frederick discussed some of the problems involved in securing adequate ventilation under various conditions. He also reviewed some of the work (to which he has himself contributed) which has already been carried out towards their elucidation.

Air is vitiated by abstraction of oxygen and by the addition of carbon dioxide, aqueous vapour, heat and bacteria, when human beings are congregated in an environment with poor ventilation. The most useful index of inadequate ventilation is the percentage of carbon dioxide present; but the discomfort experienced is not due to accumulation of this gas or to decrease in the oxygen since the greatest changes found are entirely without physiological influence. A poison in expired air has never been demonstrated; so that it is to the physical conditions of the atmosphere that one must turn for an explanation of the stuffiness of a confined environment.

Temperature, especially that registered by the wet bulb, humidity and air movement are the important factors. In estimating the degree of comfort to be expected, the cooling power of the atmosphere is of great importance: for its estimation Hill's katathermometer may be used. In America, Yaglou and his co-workers have developed the idea of 'effective temperature': with varying combinations of temperature, humidity, and velocity of air movement there is the same effect on the rate of heat loss from the body, and therefore the same sensation of comfort, or the reverse, and the same physiological response. The 'comfort' zone extends between 63 and 71 effective temperature. The results are not strictly applicable to conditions in Britain, since we are accustomed to somewhat lower temperatures.

Finally, there is the psychological or personal factor to be considered: if an occupant of a space believes the ventilation to be unsatisfactory he will suffer discomfort. Again, fresh air appears to exert a tonic effect as compared with washed and filtered air, and also to lower the incidence of minor respiratory disease. The reason for this effect is at present unknown and should form the subject of future research.

Calendar of Patent Records.

September 22, 1856.—The invention for which a patent was granted to Robert F. Mushet on Sept. 22, 1856, was very largely responsible for the immediate success of the Bessemer steel process. By the addition of from one to five per cent of molten spiegeleisen to the iron treated by the Bessemer process, Mushet regulated the supply of carbon and restored the small amount necessary for the production of steel. Mushet received little recognition at the time, and his patent did not run its full course. He was awarded the Bessemer gold medal of the Iron and Steel Institute in 1875.

September 24, 1921.—An important patent for the indiarubber industry was that granted to Paul Schidrowitz on Sept. 24, 1921, for the direct vulcanisation of rubber latex without coagulation, which enabled a vulcanised rubber in liquid form to be obtained without the necessity of a costly series of operations and expensive solvents.

September 25, 1791.—Cheap soda, for which many industries were waiting, was first produced under the process invented by Nicholas Leblanc and patented by him in France on Sept. 25, 1791. The manufacture did not become established in Great Britain until the repeal of the Salt Tax in 1823 reduced the price of salt (cf. Calendar of Patent Records, July 31).

September 26, 1836.—One of the inventors who contributed to the success of the Birmingham papier-mâché industry introduced by Henry Clay in the second half of the eighteenth century was William Brindley, paper maker. His invention for making papier-mâché articles in dies, of which the patent specification was enrolled on Sept. 26, 1836, received an award at the Great Exhibition of 1851.

September 26, 1867.—The first publication of the modern dry 'contact' process of filtering and deodorising mineral oils in which finely divided fuller's earth is mixed with the oil and the mixture subjected to constant agitation and heat, appears in the provisional specification of John Fordred, a London chemist, filed with his application for a patent for bleaching and purifying paraffin, dated Sept. 26, 1867. The patent was not sealed, but Fordred obtained later grants in which the process was applied not only to paraffin, but also to hydrocarbon oils and animal and vegetable oils and fats.

September 27, 1822.—One of the earliest improvements on the stop-watch—the construction of which in those days necessitated the stopping and restarting of the whole mechanism—was that patented by Frederick Louis Fatton, of London, a pupil of Breguet, on Sept. 27, 1822. Fatton's watch had a centre seconds hand working on a dial at the back of the case and having mounted on it apparatus capable of making a distinct mark, in ink or pencil, on the dial at any required moment, a button on the case serving to operate the mechanism without interfering with the going of the watch.

September 28, 1836.—One of the first-fruits of the introduction of the hot-blast for iron smelting was the solution of the problem of the use on a commercial scale of anthracite in the blast-furnace. The first successful production of pig-iron with anthracite was made at Yniscedwin, in South Wales, by George Crane in 1837, and the process was rapidly adopted both in Great Britain and in America. Crane's English patent for the use of anthracite with the hot-blast is dated Sept. 28, 1836. A United States patent for the same process had been granted to Dr. Geissenhainer in 1833, but no large-scale production there was made until Crane bought the patent rights and improved the process.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting at Düsseldorf), Sept. 11.—W. J. P. Rohn: The reduction of shrinkage cavities and vacuum melting. Shrinkage cavities may be diminished if care is taken that the solidification of an ingot starts from its bottom end and advances gradually to the top end. This control can be approximated with water-cooled copper moulds. Shrinkage cavities may be totally avoided if melting and freezing are performed in an electrically heated melting furnace in a crucible of the shape of a finished ingot, and, after melting and refining is completed, the current is cut off gradually from the bottom with a well-controlled speed.—M. Tama: Progress in electric furnaces for non-ferrous metals. New induction furnaces of large capacity are described. They have been developed for high melting-point alloys such as nickel-brass and phosphor-bronze. Thirty-four electric annealing furnaces of the resistor type are in successful operation in one large metallurgical plant.—N. F. Budgen: Pinholes in cast aluminium alloys. Gas evolution at solidification is the causation factor of greatest importance, and the means whereby gases may be absorbed by aluminium alloys are discussed. Shrinkage during solidification plays some part in producing pinholes.—O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of locomotive firebox stays and plates. Of the two main sections of the paper the first is devoted to a consideration of the conditions existing in a locomotive firebox. The other main section of the paper gives the results of an investigation of the oxidation of arsenical copper in firebox atmospheres. The rate of oxidation of arsenical copper in various atmospheres has been determined within the range of 260°-600° C. Small proportions of chlorine as hydrochloric acid gas and also of sulphur dioxide cause marked increase in the amount of oxidation. There was no evidence that the presence of arsenic in the copper had any influence on the rate of oxidation. The softening and elastic properties of cold-worked copper containing small percentages of other elements has also been investigated, the object being to obtain, by alloying and suitable mechanical and thermal treatment, copper, otherwise suitable for firebox purposes, which will have and retain at service temperature a reasonably high elastic limit, say, of the order of 5 tons/in.^{2} One of the most promising alloy additions is silver, of which so small a quantity as 0·05 per cent appears to be sufficient.—A. v. Zeerleder and P. Bourgeois: Effect of temperatures attained in overhead electric transmission cables. Cables made, respectively, of copper, pure aluminium, steel-aluminium, and Aldrey were submitted to temperatures lower than the usual annealing temperatures for periods ranging from several months up to one year, and the effect on the mechanical properties was examined. Aldrey is not affected by temperatures which will seriously diminish the tensile strength of copper. Cables consisting of aluminium alloys having undergone previously an appropriate heat-treatment—such as Aldrey—are thus able, in spite of their lower electrical conductivity, to be loaded with higher current densities than copper cables, without danger of slow annealing.—J. Newton Friend: The relative corrodibilities of ferrous and non-ferrous metals and alloys. (2) The results of seven years' exposure to air at Birmingham. The metals examined included tin, lead, nickel, zinc, aluminium, and various coppers and brasses. All resisted corrosion much more efficiently than the wrought iron and carbon steels. Nickel proved less resistant than copper. Aluminium ranked with lead, tin, and stainless steel in offering a very high resistance to corrosion.—C. Blazey: Idiomorphic crystals of cuprous oxide in copper. A description is given of idiomorphic crystals of cuprous oxide in copper, containing 0·43 per cent oxygen, which had been heated for a long time at a temperature above 800° C. The grain size of the copper was large and the cuprous oxide crystals were arranged in groups with uniform orientation, but in any one grain of copper the orientation of the groups varied. Long heating at a high temperature is necessary with, possibly, a favourable relationship to the crystallographic planes of the copper matrix.

PARIS.

Academy of Sciences, Aug. 12.—N. Lusin: Implicit functions.—A. Lokchine: The stability of a plate fixed between two concentric circles.—L. Escande and Teissie-Solier: The chronophotographic determination of the potential of velocities in plane flow by application of Stokes's theorem and the similitude of barrage weirs.—Mlle. Nelicia Mayer: The potential of solutions of glucides. An extension of the results obtained by Wurmser and Geloso with glucose and fructose to other glucides.—N. P. Péntcheff: The quantitative determination of neon in natural gases. The method is based on the determination of the density of the helium-neon mixture isolated from the rare gases by means of coconut charcoal cooled with liquid air. The accuracy of the method has been verified by analyses of synthetic mixtures.—A. Villachon and G. Chaudron: The amounts of hydrogen and carbon monoxide contained in some metals fused in a vacuum.—Mlle. M. Pernot: The system mercuric iodide, potassium iodide, and acetone.

Aug. 21.—Eduardo Mª Galvez: The characteristic constants of electrical generators.—Mlle. Y. Garreau and N. Marinesco: The dielectric polarisation of solutions of egg-albumen. The experimental results are shown on a diagram giving the dielectric constant as a function of the *p*H of the solution.—Mme. N. Demassieux: The action of alkaline carbonates on lead chloride. The equilibria have been studied by the method of electrical conductivity: phosgenite $(PbCl)_2CO_3$ is the first product, and further additions of sodium carbonate transform this into lead carbonate.—G. Favrel: The formation of mixed azo bodies corresponding to the alkylacetylacetones.—Joseph Robin: The formation of rubrene starting from non-chlorinated derivatives. Esters of the type

$$(C_6H_5)_2 . C(O . CO . R) . C : C . C_6H_5$$

heated under certain conditions give rubrene. The reaction is violent with the acetate, more moderate with the propionate, butyrate, and benzoate. The yield of rubrene is a maximum with the acetate.—J. Régnier: The action of alkaloids of the cocaine type on the nerve trunks. Comparison of their activity on the sensitive fibres with their activity on the motive fibres. Similar experiments to those already described with cocaine have been carried out with the hydrochlorides of pseudococaine, novocaine, racemic stovaine, dextrorotatory stovaine, lævorotatory cocaine, butelline, and tutocaine.—P. Grassé and Mlle. O. Tuzet: The tegosomes in the spermatogenesis of the prosobranch molluscs and their relations with the nucleus.

SYDNEY.

Linnean Society of New South Wales, July 31.—J. R. Malloch: Notes on Australian Diptera (20). Contains notes on Calyptrate Diptera and is a final contribution on the genus *Rutilia*. Eight genera and twenty-four species from Australia and one genus

from New Zealand are described as new. Keys are given to the genera of Australian Tachinidæ.—G. E. Nicholls: Some new species of *Stenetrium* from Western Australia. Description of one species from Dongarra, obtained from seaweeds on the piles of a disused pier some six feet or more below the surface of the water, and three species from Bathurst Pt., Rottnest Island.—H. G. Raggatt: Note on the structural and tectonic geology of the Hunter Valley between Greta and Muswellbrook, with special reference to the age of the diastrophism. An orogenic movement took place in Tertiary time which was, to a considerable extent, responsible for the formation of the meridionally arranged structures such as the Lochinvar dome and the Muswellbrook structure. The problem remains of determining the relative importance of the movements in the late Palæozoic and Tertiary eras.—G. H. Hardy: Fourth contribution towards a new classification of the Australian Asilidæ. The characters to be used include those of certain thoracic sclerites, part of which have not hitherto been discussed. Species under tribe Laphriini are reviewed, only one generic conception being regarded as valid. Three more tribes are considered necessary for including certain genera of the Dasypogoninæ.

Royal Society of New South Wales, Aug. 7.—A. R. Callaghan: The development of the inflorescence of *Avena sativa* L. Relative morphological features of the oat inflorescence are discussed, and a scheme of panicle branching, as propounded by Fernekess, is figured and explained. Only one primary branch arises from each node in the rachis; subsequent branching is of a secondary nature. Various expressions of false nodes in unilateral panicles are described and figured. The development of the inflorescence is correlated with vegetative developmental phases. Relationship of inflorescence development to the physiological conditions of 'oat blast' and 'bolting', to frit fly (*Oscinella frit*) attack, and to the grazing problem is discussed.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 6, June 15).—H. C. Ramsperger, M. E. Nordberg, and R. C. Tolman: The rate of decomposition of nitrogen pentoxide at moderately low pressures. The reaction was observed in a 45-litre flask to minimise the effect of adsorption on the walls, and initial pressures varied from 5 mm. to 1 mm. of mercury. In these conditions nitrogen pentoxide shows no change in its specific first-order rate of decomposition.—Oscar Knefler Rice: Types of unimolecular reactions. A discussion of predissociation, unimolecular and also photochemical decompositions of complex organic compounds in the gaseous state.—Ralph E. Winger and Don M. Yost: The valence of sulphur in dithionates. Measurements of the position of the *K*-absorption edge of potassium dithionate indicate that the two sulphur atoms are equivalent.—Wanda K. Farr: Studies on the growth of root hairs in solutions: the *p*H molar-rate relation for *Brassica oleracea* in calcium sulphate. Three-dimensional graphs were prepared showing amount of growth at varying concentration and *p*H values.—Harold D. Babcock: Some new features of the atmospheric oxygen bands, and the relative abundance of the isotopes O^{16}, O^{18}. Intensity measurements indicated the ratio 1 : 1250 for the isotope O^{18} to O^{16} in agreement with Aston's mass-spectrograph results.—Edward W. Berry: Fossil plants and mountain uplift in the Pacific States. The fossil plants of the Spokane area are mesophytic in type and Upper Miocene in age. Moisture-carrying winds making such vegetation possible have been cut off by the elevation of the Cascade Range, which is thus considered to have happened in not earlier than very late Miocene time.—Francis B. Sumner: The analysis of a concrete case of intergradation between two subspecies. (2) Additional data and interpretations. Reconsideration of earlier data leads to the view that the colour changes of the two races of *Peromyscus* studied afford an example of protective coloration achieved through differential survival of paler variants. The cause of the abrupt transition between the ranges of the two races remains obscure.—Oscar Zariski: On the linear connexion index of the algebraic surfaces $z^n = f(x, y)$.—Thomas Harper Goodspeed and Priscilla Avery: The occurrence of a *Nicotiana glutinosa* haplont.—Edwin H. Hall: Further remarks concerning thermionic '*A*' and '*b*', a revision and an extension.—F. Rasetti: On the Raman effect in diatomic gases (2). Amplification and correction of the communication in NATURE, May 18, p. 757.—Allan C. G. Mitchell: On the theory of electron scattering in gases. The Born collision theory is used in connexion with the Fermi statistical potential for atomic fields.—Louis A. Turner: Molecular binding and low ^5S terms of N^+ and C.—J. A. Bearden: Wave-length of the *K*-lines of copper using ruled gratings. A glass grating of 600 lines per mm. and a glass and a speculum grating each with 50 lines per mm. were used, and exposures varied from twenty-four hours to seventy-two hours. The wave-lengths obtained were always greater than those obtained from crystal diffraction data (see also NATURE, Aug. 24, p. 319).—E. O. Salant: Effect of volume changes on the infra-red vibrations of simple crystals. A theoretical discussion indicates that the effects should be measurable.

Official Publications Received.

BRITISH.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929. Vol. 41, August. Pp. 455-551. (London.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1929–30. Pp. 325. (Manchester.)

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1928. Pp. 43+1 plate. (Entebbe.) 3*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1229 (Ae. 384): Loads on the Main Planes and Tail of an Aeroplane when recovering from a Dive. By H. Bolas and G. A. Allward, of Messrs. George Parnall and Co. (T. 2673.) Pp. 24. 1*s*. net. No. 1235 (Ae. 390): On the Stability of Controlled Motion. By W. L. Cowley. (T. 2695.) Pp. 9+3 plates. 9*d*. net. No. 1183 (M. 57): The Behaviour of a Single Crystal of Zinc subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 212.) Pp. 32+9 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Society for Psychical Research. Part 112, Vol. 39, August. Pp. 192. (London: Francis Edwards, Ltd.) 8*s*.

The Journal of the Institute of Metals. Vol. 41. Edited by G. Shaw Scott. Pp. xii+825+42 plates. (London.) 31*s*. 6*d*. net.

Australasian Association for the Advancement of Science, Hobart Session, 1928. General Observations on the Australian Flora. By J. W. Audas. Read before the Australasian Association for the Advancement of Science, Tuesday, 17th January 1928. Pp. 23. (Sydney, N.S.W.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1928. By Dr. H. A. Tempany. Pp. 17. (Kuala Lumpur.)

Journal of the Chemical Society: containing Papers communicated to the Society. August. Pp. iv+1623-1849+xii. (London.)

Queensland. Department of Agriculture and Stock: Division of Entomology and Plant Pathology. Pests and Diseases of Queensland Fruits and Vegetables. By Robert Veitch and J. H. Simmonds. Pp. 198+64 plates. (Brisbane: A. J. Cumming.)

Proceedings of the Society for Psychical Research. Appendix to Part 3, Vol. 38. Pp. 518-560. (London: Francis Edwards, Ltd.) 2*s*. 6*d*.

Union of South Africa: Department of Agriculture. Science Bulletin No. 79: Official Soil Map of the Union of South Africa, with Explanation compiled in the Office of the Soil Survey. (Division of Chemistry Series, No. 94.) Pp. 12+1 plate. (Pretoria: Government Printer.)

East London College (University of London). Calendar, Session 1929–1930. Pp. 194. (London.)

The Botanical Society and Exchange Club of the British Isles. Vol. 8, Part 5: Report for 1928 (with Balance-Sheet for 1927), by the Secretary, Dr. G. C. Druce. Pp. 595-800+xxxviii+112+37 plates. (Arbroath: Printed by T. Buncle and Co.) 10*s*.

FOREIGN.

Bernice P. Bishop Museum. Bulletin 58: Growth of Hawaiian Corals. By Charles Howard Edmondson. Pp. 38+5 plates. Bulletin 59: Ferns of Fiji. By Edwin Bingham Copeland. Pp. 105+5 plates. Bulletin 60: Archaeology of Tonga. By W. C. McKern. (Bayard Dominick Expedition, Publication No. 15.) Pp. 123+6 plates. Bulletin 61: Tongan Society. By Edward Winslow Gifford. (Bayard Dominick Expedition, Publication No. 16.) Pp. iv+366+1 plate. Bulletin 62: Lau Islands, Fiji. By A. M. Hocart. Pp. iv+241+4 plates. Bulletin 63: Measurements and Landmarks in Physical Anthropology. By Frederic Wood Jones. Pp. 67. Bulletin 64: Food Values of Bread-Fruit, Taro Leaves, Coconut and Sugar Cane. By Carey D. Miller. Pp. 23. (Honolulu.)

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 6, No. 11: Wave Lengths and Atomic Levels in the Spectrum of the Vacuum Iron Arc. By Keivin Burns and Francis M. Walters, Jr. Pp. iii+159-211+7 plates. (Pittsburgh, Pa.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 18, No. 2. Pp. 155-302+2 plates. (Tokyo and Sendai: Maruzen Co., Ltd).

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 123: Farm Milk Houses. By F. E. Fogle and P. S. Lucas. Pp. 7. Circular Bulletin No. 124: The Young Vineyard. By N. L. Partridge. Pp. 16. Circular Bulletin No. 126: Essentials of a Mulch Paper Laying Machine. By H. H. Musselman. Pp. 7. Special Bulletin No. 183: Common Pests of Field and Garden Crops. By R. H. Pettit. Pp. 77. Special Bulletin 190: Oak Forests of Northern Michigan. By Joseph Kittredge and A. K. Chittenden. Pp. 47. Technical Bulletin No. 99: Defective Graft Unions in the Apple and Pear. By F. C. Bradford and B. G. Sitton. Pp. 106. (East Lansing, Mich.)

Department of the Interior: U.S. Geological Survey. Bulletin 797-B: The Skwentna Region, Alaska. By Stephen R. Capps. Pp. ii+67-98+1 plate. 15 cents. Bulletin 797-E: Aerial Photographic Surveys in Southeastern Alaska. By R. H. Sargent and Fred H. Moffit. Pp. ii+143-160+plates 4-5. 15 cents. Bulletin 797-F: Geology and Mineral Resources of the Aniakchak. By Russell S. Knappen. Pp. ii+161-227+plate 6. 20 cents. Bulletin 805-B: Deposits of Vermiculite and other Minerals in the Rainy Creek District, near Libby, Montana. By J. T. Pardee and E. S. Larsen. Pp. ii+17-29+1 plate. Bulletin 806-B: The Northward Extension of the Sheridan Coal Field, Big Horn and Rosebud Counties, Montana. By A. A. Baker. Pp. iv+15-67+plates 6-29. 45 cents. Bulletin 806-C: Geology and Oil and Gas Prospects of part of the San Rafael Swell, Utah. By James Gilluly. Pp. iv+69-130+plates 30-35. 25 cents. Bulletin 806-D: Geology of the Rock Creek Oil Field and adjacent Areas, Carbon and Albany Counties, Wyoming. By C. E. Dobbin, H. W. Hoots, C. H. Dane and E. T. Hancock. Pp. iv+131-153+plates 36-43. 20 cents. Bulletin 806-E: Thrust Faulting and Oil Possibilities in the Planes adjacent to the Highwood Mountains, Montana. By Frank Reeves. Pp. iv+155-195+plate 44. 10 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 593: Surface Water Supply of the United States, 1924. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+264. 30 cents. Water-Supply Paper 594: Surface Water Supply of the United States, 1924. Part 13: North Pacific Slope Drainage Basins. C: Lower Columbia River Basin and Pacific Slope Drainage Basins in Oregon. Pp. vi+215. 30 cents. Water-Supply Paper 595: Surface Water Supply of Hawaii, July 1, 1923 to June 30, 1924. Pp. iv+157. 20 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

FRIDAY, SEPTEMBER 20.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District) (at Hulme Hall, Port Sunlight), at 11 A.M.—P. Parr: Development and Works in the Bebington and Bromborough District.

MONDAY, SEPTEMBER 23.

NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (at Technical College, Stoke-on-Trent), at 5.—J. A. Bloor: Notes and Suggestions on the Underground Transport of Workmen.

THURSDAY, SEPTEMBER 26.

IRON AND STEEL INSTITUTE (at Chamber of Commerce, 95 New Street, Birmingham), at 7.30.—Discussion on following papers:—Constitutional Diagrams for Cast Irons and Quenched Steels, A. L. Norbury; Iron-Silicon-Carbon Alloys: Constitutional Diagrams and Magnetic Properties, T. D. Yensen.

FRIDAY, SEPTEMBER 27.

INSTITUTE OF MARINE ENGINEERS (at Olympia), at 6.30.—H. Barringer: Modern Tanker Practice (Lecture).

INSTITUTION OF MUNICIPAL AND COUNTY ENGINTERS (in Isle of Ely).

SATURDAY, SEPTEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (in Isle of Ely).

CONFERENCES.

SEPTEMBER 20–23.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).

Friday, September 20, at 6.45.—Reception of Delegates by the Council of the Association.

At 7.15.—Dinner. Address by Sir J. J. Thomson, the President-elect.

At 8.30.—Brig.-Gen. M. Mowat: The Year's Work of the Association.—Laurie Magnus: The Approach of the Producer to the Consumer of Information.

Saturday, September 21, at 10 A.M.—S. H. Hamer: The Preservation of Places of Natural Beauty and Historic Interest.—A. Parker: Duplicating Machinery: A Survey of Modern Methods.—E. J. MacGillivray: Duplication, and Infringement of Copyright.—Dr. W. Bonser: The Ideal Form of a Journal from the Librarian's Point of View.

At 5.30.—Annual General Meeting.

At 8.30.—G. T. Hankin: Books versus Text-books, the Problem of the Schools.—R. A. Austen-Leigh: Organised Information in the Printing Trade.—E. W. Ashcroft: Technical English.—E. Green: The Information Service of a Public Library.—P. A. Green: The Information Service of a Bank.

Sunday, September 22, at 10 A.M.—A. F. Ridley: The Training of Special Librarians.—H. Rottenburg: Indexing and Classifying of Individual Collections of Data.—A. P. L. Gordon: Sources and Application of Business Data.—E. T. Elbourne and H. G. T. Cannons: An Indexing System for Published Business Information.

At 8.30.—P. Otlet: International Organisation of Information Services.

SEPTEMBER 24 AND 25.

FARADAY SOCIETY (General Discussion on Molecular Spectra and Molecular Structure) (in Physics Department, University, Bristol).

Tuesday, September 24, from 2.30 to 4.30 and 5 to 7 P.M.—General Introduction by Prof. W. E. Garner and Prof. J. E. Lennard-Jones.

Part I. Band Spectra in Visible and Ultra-Violet.

Introductory Paper.

Band Spectra in Visible and Ultra-Violet.—Prof. O. W. Richardson.

Special Papers.

(*Personal Researches.*)—Prof. H. A. Deslandres.

The Band Spectrum of Helium.—Prof. W. E. Curtis.

The Detailed Electronic Structure of Molecules.—R. C. Johnson.

Band Spectra and Atomic Nuclei.—Prof. R. S. Mulliken.

Recent Work on Isotopes in Band Spectra.—Prof. R. T. Birge.

The Isotope Effect in the Absorption Spectrum of ICl.—Prof. J. Patowski and Prof. W. E. Curtis.

Chemical Binding.—Prof. F. Hund.

The Determination of Heats of Dissociation by Means of Band Spectra.—Prof. R. T. Birge.

The Recombination Spectra of Halogens and the Probability of the Molecule Building from the Atoms.—Prof. V. Kondratjew and A. Leipunsky.

Adsorption Spectra of Simple and Complex Molecules in Ultra-Violet. Predissociation and Dissociation of these Molecules.—Prof. V. Henri.

New Investigations on the Band Spectra of Metal Hydrides.—Prof. E. Hulthen.

Metallic Band Spectra.—S. Barratt.

Visible Band Spectra in Some Crystalline Salts of the Rare Earths.—F. I. G. Rawlins.

Wednesday, September 25, from 10.30 A.M. to 12.30 P.M., and 2.30 to 4.30 P.M.

Part II. Raman Effect.

Introductory Paper.

The Raman Effect.—Sir C. V. Raman.

Special Papers.

(*Raman Effect.*)—Prof. R. W. Wood.

(*Raman Effect.*)—Prof. J. C. McLennan.

The Degradation of Luminous Frequencies—Molecular Diffusion.—Prof. J. Cabannes.

Polarisation of Raman Radiations in Liquids and Crystals.—Prof. J. Cabannes.

A Study of the 'Raman Effect' in Some Liquefied Gases.—Prof. P. Daure.

Raman Lines in the Spectrum of the Electric Discharge.—Prof. H. S. Allen.

The Raman Effect of AX_4 Ions in Solution.—Prof. A. M. Taylor.

A Note on the Plane Polarisation of the Raman Spectra.—A. C. Menzies.

Part III. Infra-Red Spectra.

(a) *Solids.*

Introductory Paper.

Infra-Red Spectra in Solid Media.—Prof. C. Schaefer.

Special Papers.

The Infra-Red Spectra of Chemical Radicles.—Prof. A. M. Taylor.

The Band Spectrum of $KMnO_4$ in the Crystalline State and in Solution.—Prof. A. M. Taylor.

(b) *Liquids.*

Introductory Paper.

The Study of Infra-Red Spectra in Liquid Media.—Prof. J. Lecomte.

Special Papers.

On the Ultra-Red Lines of Hydrogen Combined with Carbon in the Molecule of Organic Compounds.—Prof. G. B. Bonino.

Molecular Absorption Spectra of Liquids below 3μ.—Prof. J. W. Ellis.

(c) *Gases.*

Introductory Paper.

Infra-Red Spectra of Gases.—Sir R. Robertson.

Special Papers.

On the Infra-Red Spectra of Gases under High Dispersion.—Prof. E. F. Barker and Prof. C. F. Meyer.

Chemical Structure and Infra-Red Analysis.—Dr. E. K. Rideal.

The Form of the Molecule of Carbon Dioxide—Evidence from the Infra-Red.—F. I. G. Rawlins.

The Infra-Red Spectra of Sulphur Vapour.—Prof. A. M. Taylor.

Vibration-rotation Spectra of Diatomic Molecules.—C. P. Snow.

Public Library

NATURE

SATURDAY, SEPTEMBER 28, 1929.

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The Economic Position of Backward Peoples.

WHEN the British Association visited South Africa in 1905, the country was still suffering from the effects of the Boer War. Of the many problems which had demanded solution, the most acute had been that of labour. In the efforts to restore social and economic equilibrium, the mining industry had made demands upon the native labour supply which it had been unable to meet, and after strenuous opposition and an acrimonious exchange of opinion from opposing camps, not only in South Africa but also in Great Britain, a solution had been sought by the introduction of Chinese labour —a solution which failed, perhaps happily for the future of the country. The difficulties of the situation were not relieved by the settlement in South Africa of large numbers of natives of India, who indeed both at that time and afterwards added to the gravity of the situation in further complicating the relations of the white and coloured populations both politically and economically.

In the period which has elapsed between the first and second visits of the British Association to South Africa, there have been many changes, but fundamentally the situation in regard to the racial question remains unaltered. Notwithstanding the attempts which have been made to secure some *modus vivendi* between white and black which will secure for the latter opportunity for social, economic, and political development with due regard to the interests of South Africa as predominantly a white man's country, the problem has still to be solved.

On one side the native question in South Africa has naturally much in common with the situation that arises elsewhere whenever a backward people is brought into contact with European civilisation. The exploitation of the resources of the country brings a demand for cheap and plentiful labour which the native is induced to satisfy by the acquisition of new desires for the objects, material and other, which are brought within his reach by European culture. These are not necessarily in themselves entirely harmful, although experience in the past has shown that more often than not the result of the contact has been disastrous. The provision of facilities for a higher standard of living, an improved system of sanitation and hygiene, a medical service, and opportunities for education, are now generally recognised as normal activities of the administration in our dependencies which have any appreciable native population.

The practice of earlier days ignored the interests of the natives, leaving them more or less at the mercy of the exploiting trader or settler. It made little or no effort to protect them against the vices of civilisation except in so far as was necessary to safeguard the white population. On the other hand, the modern type of humanitarian administration is not without its drawbacks. Too often it leads to the disintegration of native tribal organisation and the breaking up of the indigenous moral and religious code. It is one of the problems of the administrator to provide against the dangers of this disintegration. In any case, it can no longer be regarded as an adequate solution that the native should remain a hewer of wood and drawer of water under the white man's control, however benevolent; nor does the provision of facilities for education, even technical education, along the lines of our civilisation, meet the needs of the case, as was once thought. Development must be along lines concordant with native culture.

In most tropical countries, climatic conditions make it inevitable that the European should be only a small and transient element in the population. Yet a day must come when the development of tropical countries of suitable soil will no longer be a question of the individual gain of a pioneer settler, but the outcome of a world-wide necessity created by the normal increase in world population. This is a fundamental factor in the situation which ultimately must have a decisive effect in shaping the destiny of the backward peoples. On a long view, reservations or any other means of segregation can at best only be regarded as temporary protective measures for educative purposes; in the end, native populations, to use a convenient conventional term, must come under the full play of economic forces and enter into competition with the rest of the world as productive units under penalty of extinction. It is both a moral and a political duty, in the broader sense, incumbent upon the advanced peoples who are in contact with backward races, that they should prepare them for the ordeal. They must so guide their development that, while they are guarded from the effects of the premature breaking up of their own civilisation, they may be trained gradually to take their place in the economic system of the peoples of the world.

The danger of any attempt at premature social and economic development of native populations was one point which was particularly stressed by Mr. Henry Balfour when speaking at a discussion on " The Economic Competition between Advanced and Backward Peoples " which took place at a joint meeting of Sections F (Economics) and H (Anthropology) on July 25 at Cape Town during the recent meeting of the British Association. Though it was intended that the discussion should deal with general principles rather than particular instances, it was inevitable that the difficulties of the situation in South Africa should take a prominent place. Many of these added point to Mr. Balfour's remarks.

In opening the discussion, Prof. H. Clay pointed out that while economic competition between advanced and backward peoples is possible without their being in propinquity, if they are in contact this adds the colour of emotion to the difficulties of the economic competition. Here he placed his finger upon one of the fundamental problems of the situation. Racial antagonism, always acute in such conditions, is emphasised by the colour bar. As he pointed out, backward peoples lack power of direction and, on the whole, take over the simpler processes from the more advanced peoples, freeing the latter for more advanced industries.

Now while it would be possible to point to areas, especially areas such as West Africa in which the white population is relatively small, where this principle, it may be hoped, is leading to the gradual development of native capabilities with a minimum of dislocation, in South Africa, an area with a comparatively long history of white settlement behind it and a large population of detribalised natives, the black comes into competition with the poorer class of white, and tends to displace this class on the economically unsound practice of less pay for coloured labour. It is encouraging from some points of view that among the more skilled coloured labourers some may now earn more than a white. In other words, the black, in the play of political and economic forces, is coming to earn as a producing unit without regard to his colour.

To sum up the discussion in one general impression, it would almost be fair to say that the social and economic problem of South Africa is the poor white rather than the black. Notwithstanding the grave signs of unrest among the natives which have been apparent recently, and especially during the past few weeks, the whole economic situation would appear to be changing slowly in favour of the native population. Yet much ground has to be covered before anything like equilibrium is attained, and whether that is desirable is a social and political question which raises entirely different issues. Here we enter on the field of emotion.

The Locust Problem.

Locusts and Grasshoppers: a Handbook for their Study and Control. By B. P. Uvarov. Pp. xiii + 352 + 10 plates. (London: The Imperial Bureau of Entomology, 1928.) 21*s.* net.

THE entomologist working in the field in remote parts of the world is often seriously handicapped by the lack of literature; he requires a few handy books of reference that he can conveniently carry with him, books to which he can turn in times of need for reliable information concerning the different phases of his work. Such a book is Mr. B. P. Uvarov's "Locusts and Grasshoppers": it is a masterly survey of the whole locust problem by one who has made the subject peculiarly his own. But the author has done far more than to compile a mere survey of the vast and scattered literature that has grown up around the locust problem; he has sifted and sorted his material in a manner that only one with his wide field experience and intimate knowledge of the subject could have done; he has rejected the worthless, indicated the doubtful, and given due prominence to the important and well-established contributions. Furthermore, he has added a running commentary of his own which adds greatly to the value of the book.

Another very valuable feature of the book consists of the many suggestions put forward by the author concerning lines along which further investigations should be undertaken. It comes as a surprise and a shock to one who has long been connected with locust work to find how many serious lacunæ in our knowledge Mr. Uvarov can point out, in spite of the voluminous literature and the many workers busy with the subject in different parts of the world. For example, he indicates clearly how fragmentary and unsatisfactory is our knowledge of the organs of chemical perception (as he calls the organs of smell, taste, etc.) of the Acrididæ; information that is almost essential when one comes to deal with poison baits, spray fluids, reactions to certain stimuli, and so on, is totally wanting. Again, we learn that we know very little indeed about the tympanal organs, or so-called ears of the locusts, and on p. 29 the author says: "The unquestionable importance of the tympanal organs in the behaviour of the *Acrididæ* makes detailed experimental studies of their function vitally necessary." Later on (on p. 34) we read: "The estimation of the period necessary for the development of the embryo is of great practical interest, but the problem has as yet been very insufficiently studied". Again, on page 37: "The data relating to the effect on development of excessive moisture are exceedingly vague and do not permit of any safe conclusion." "Summarising all that has just been said about the influence of external factors on the development of the embryo in the *Acrididæ*, we must admit that our knowledge on this point of great practical importance is very limited and very inexact." "Of practical interest would be an exact experimental study of the emergence of larvæ through layers of earth of various thickness and of varying physical properties, because this would give some indications of the possible effect of various agricultural methods on the emergence of the larvæ" (p. 42). "Only in a relatively small number of species (mainly Russian) have the egg-pods been studied and the subject offers a large field for study by an entomologist" (p. 60). "The problem [of the number of egg-pods laid per female] has not been studied at all in the case of the solitary species" (p. 61). The author points out the urgent need for further studies on the reactions of the insects to different stimuli and says: "The problem presents an almost unexplored field for most interesting observations" (p. 66).

Uvarov insists on the importance of an exhaustive study of the influence of temperature on the behaviour of locusts, "for the body temperature of the insect must be the actual factor determining its physiological activities. Unfortunately, this side of the problem has never been studied, though we shall see later, when discussing the behaviour of swarming locusts, that with it is connected the solution of the main problems of mass migration, as well as those of periodicity of locust invasions" (p. 70).

"The attraction of locusts by certain chemicals [in poisoned baits] has found such an enormous field of practical application that one would naturally expect that the theoretical foundations of such a method had been thoroughly investigated. This, however, is not the case, and our actual knowledge of the influence of various chemicals on the behaviour of the *Acrididæ* is incredibly small" (p. 72). We are told on p. 73 that "we know absolutely nothing concerning the food of the vast majority of species not known as pests". "Unfortunately, there are no data on the chemistry of nutrition in *Acrididæ*." "The very important and interesting question of the quantity of food required for the development of a single individual remains practically unstudied" (p. 75). On p. 108 we are told that "our knowledge of this group [of blister

beetles], as parasites of the *Acrididæ*, is very meagre, the triungulin stage being known for one species only, while the information on the habits and parasitic activities of each species is of a most fragmentary nature. This makes an estimate of the economic importance of these undoubtedly serious enemies of *Acrididæ* practically impossible."

The above quotations, taken at random, will serve to show how necessary and useful is such a survey as that which Mr. Uvarov has given us; besides giving us an adequate summary of the work done and results achieved to date in different parts of the world, he indicates clearly the many lines along which further investigations are needed—a feature of the book that will be greatly appreciated by all entomologists working on the locust problem in the field.

A brief account of the external morphology of the Acrididæ is given in the first chapter of the book, and this is followed by chapters on anatomy and physiology, development and transformations, behaviour, ecology and distribution, natural enemies, periodicity of mass outbreaks, the technique of control, organisation of control; the second half of the book is taken up with full accounts of the different species of locusts and solitary grasshoppers of economic importance that are found in different parts of the world.

The chapter on "Periodicity of Mass Outbreaks" contains a most interesting discussion of the theory of phases of locusts, a theory tentatively put forward as a working hypothesis by Uvarov in 1921. Since this date a great deal of evidence in support of the theory has been gathered, and it promises to have a very important bearing on the whole locust problem. Briefly, the theory is as follows: Various species of gregarious locusts cannot be considered absolutely stable in all their characters, either morphological or biological; on the contrary, there are good reasons for regarding each species as exceedingly plastic and liable to fluctuations in all essential characters. These fluctuations have, of course, certain limitations, but in some cases the bounds are so wide that the extreme forms were often recognised as distinct species. These extreme forms represent what Uvarov calls the 'phases' of the species, one of them being a typical swarming locust in all its biological characteristics, whilst the other is a typical solitary grasshopper. The extreme forms are connected by a continuous series of intermediate ones and no definite dividing line can be drawn.

The fluctuations of specific characters in the direction of one phase or the other usually occur in a given locality simultaneously in all individuals of the species, and this is connected with the periodicity of outbreaks. Overcrowding, for some totally unknown reason or reasons, causes a species to assume the 'swarm phase' characteristics, with the distinct coloration, structure of the pronotum, gregarious instincts, and so on. When the swarm gets thinned out by disease, natural enemies and control measures, the survivors tend to separate and assume the characters of the solitary phase. With the return of favourable conditions, these solitary individuals breed up again rapidly, the gregarious instinct begins to reassert itself, and the swarm phase is once more assumed, maybe after an interval of several years.

Uvarov put forward his theory as a result of his studies of *Locusta migratoria* in the Northern Caucasus, but since then a similar state of affairs has been found to occur with the brown locust of South Africa, the desert locust of the Sudan, and the South American locust, *Schistocerca paranensis*. The whole question is of the utmost interest, not only to the economic entomologist but also to the systematist, the geneticist, the ecologist, and the physiologist; an entirely new and fascinating field of study was opened up when Uvarov showed that *Locusta migratoria* and *Locusta danica* were one and the same species in different 'phases' of its existence.

The two chapters on the technique of control and the organisation of control are very full and suggestive and they are remarkable for the wide practical experience and sound common-sense revealed by the author. On the whole, he seems to be of opinion that there is little future for biological control methods, so far as locusts are concerned; of the artificial methods, he favours the use of poison baits and dry-dusting methods.

Of the second part of the book, dealing with the species of locusts found in different parts of the world, the reviewer is competent to judge only of the chapter on South African locusts. This chapter contains an accurate summary of the position in South Africa and of our knowledge of the brown and red locusts. If the remainder of this section is similar (and there is no reason to doubt it), then the latter half of the book contains the most complete and reliable account of the locusts of the world that is available.

In the last chapter Uvarov pleads convincingly for the organisation of locust research on an international scale. He points out how spasmodic, fragmentary, and unsatisfactory much of the

nvestigational work has been in the past, due in he main, he thinks, to the suddenness of the out-reaks and the equal suddenness of their disappear-nce. During the intervals when the locusts are ot troublesome, the work is dropped, only to be astily resumed when the swarms sweep over the ountry again. The work has suffered severely wing to the lack of continuity and of co-ordina-ion. Uvarov puts forward a very strong plea for he establishment of permanent laboratories where erious, long-period studies of the physiology, cology, bionomics, etc., of the Acrididæ can be ndertaken in accordance with a definite, carefully lanned and co-ordinated scheme. It is to be oped that the authorities concerned will not turn deaf ear to his convincing arguments.

The book is well printed, well illustrated, and trongly bound. It is undoubtedly one of the ost important entomological works that has ppeared in recent years, and the author has ren-lered a most valuable service in undertaking the aborious task and carrying it to such a successful nd creditable conclusion. G. H. Skaife.

Energy and Heat.

1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 8, Teil 1: *Energie- und Wärmeinhalt.* Bearbeitet von Prof. A. Eucken. Pp. xv + 736. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 65 gold marks.

2) *Lehrbuch der Thermodynamik: für Studierende der Chemie und verwandter Wissenschaften.* Von Prof. A. Magnus. Pp. xii + 288. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 18 gold marks.

1) THE name of the author of this volume of the Wien-Harms "Handbuch" is a ufficient guarantee of its thorough and authorita-ive character. The subject matter can be briefly ummarised by saying that it includes the whole f the science of energy (internal energy, E,η or U) or unaccelerated bodies and of enthalpy (*Enthalpie, Wärmeinhalt*, heat contents, total heat, $U+pv$), ooked at mainly from the experimental point of iew, together with enough thermodynamics or as theory to make the whole intelligible. Allied roblems, such as the production of high and low emperatures, properties at high and low pressures, he liquefaction of gases, and heat engineering in eneral, are dealt with in other volumes of the eries.

It is no slight task at the present day to write a treatise on any experimental branch of physics. Not only must a man have knowledge of the work being done at the four or five leading standardising institutions in the world, but also he must be acquainted with multifarious separate publications from almost countless laboratories. The growth of experimental knowledge has led to a revision of theories, and this in its turn has reacted and served as a stimulus for fresh experimental work. This is well illustrated by the section concerning specific heats (p. 410). Our knowledge of their values at low temperatures alone is a new science (p. 40) intimately connected with the theoretical work of Planck, Nernst, Debye, and Eucken himself. Contrast the old and the new again in other cases where theory gives very little help, for example, on the transformation point in the value of C_p for nitrogen (solid) at 36° Abs. (Keesom, Kamerlingh Onnes, Eucken, Clusius), in addition to the melting-point at about 63° Abs. with a continuation of determinations down to 10° Abs. Concerning the speculative nature of the underlying theory, twelve different formulæ are given as having been published since 1913 for the rotational specific heat of hydrogen (gas).

The book is to be commended for a very full discussion of the effect of pressure upon the specific heat of gases. On the theoretical side this might be amplified by recognising that, almost from the beginning, it has been known that van der Waals' a is not independent of temperature. Numerous diagrams are given for various gases; some of the data for these at low temperature being deduced from experiments on the Joule-Kelvin effect (Hansen).

The question of the specific heats of dissociating gases receives attention. This discussion is based on the simple reaction-isochore. Applied to nitrogen peroxide, values of C_p are calculated which tally well with the experimental results of McCollum and of Berthelot and Ogier. Unfortunately, this theory will break down long before the critical region is approached, so that it will be quite inapplicable to steam near the critical point: it provides, therefore, no test of Callendar's recently obtained data. Chapter xi. deals with energy and enthalpy as functions of state (37 pp.); here the isenthalpic throttle effects receive very full treatment. Of the newer matter, the experimental investigations of Hansen (air), Roebuck (air), and of Jenkin and Pye (carbon dioxide) are given with full diagrammatic illustration. Of theoretical values calculated from empirical equations nothing is

given except the determination of volume and temperature at inversion points from van der Waals' equation. A footnote indicates a laborious process by which the corresponding pressures and temperatures can be obtained. It does not seem to have been noticed that it is quite easy to eliminate v from the equations and thus obtain a parabola for the p, T inversion curve. If this is done, interesting properties are revealed which are here passed over in silence.

The rest of the volume is concerned principally with heat changes during transformations of phase (vaporisation, melting, mixing, adsorption, etc.).

The above brief sentences give only a poor idea of the contents of this volume. One of the most important features consists in the excellent illustration by means of diagrams of apparatus and graphs. The whole constitutes one of the most complete treatises on the subject.

(2) The small volume by Prof. A. Magnus is of a totally different kind. It is an elementary book on the subject written mainly for students of chemistry, particular pains being taken not to slur over the mathematical theorems which are involved. With this aim there is a mathematical introduction explaining the processes of partial differentiation and integration. This is all to the good, and it may at once be said that the author has succeeded in giving a very lucid explanation. The remainder of the book consists of the usual applications to simple chemical reactions, terminating with a chapter on Nernst's heat theorem.

One thing it lacks. There are no references to other sources of information except in the final chapter. This detracts from its usefulness. The impression that the student will receive is that the book includes all that is known about chemical thermodynamics. So far as the book goes, however, it can be recommended. The style is simple, and a student beginning to read German would find it a useful text-book on which to practise.

Igneous Rocks.

The Evolution of the Igneous Rocks. By N. L. Bowen. Pp. x + 334. (Princeton: Princeton University Press; London: Oxford University Press, 1928.) 23*s.* net.

IN the middle of the last century much interest was shown in the problem of the genesis of igneous rocks, and especially in the manner of origin of diverse rock-types from a common stock or from a limited number of primitive 'magmas'. The speculations of De Beaumont, Bunsen, Durocher and others suffered from the lack of any adequat basis either in petrographical knowledge or i chemical theory. Later, with the advent of th microscope in petrology, there came a great ac cumulation of material on the descriptive side, an meanwhile physical chemistry was making rapi progress.

Prof. Vogt of Trondhjem was the first to attemp a reasoned discussion of the crystallisation of igneou rock-magmas, using primarily a mass of data de rived from the technological study of slags. I became apparent, however, that any serious ad vance must be based upon experiment designed fo the purpose and conducted with the precision mad possible by modern laboratory methods. Thi want was at length supplied by the Geophysica Laboratory at Washington, opened in 1907 unde the direction of Dr. A. L. Day. Since that time, staff of skilled chemists has investigated numerou silicate-systems chosen to throw light upon petro genesis; and in pointing the application of thes results, Dr. Bowen, as interpreter between th chemist and the petrologist, has taken a leadin part.

The first and larger part of the present work em bodies, in the main, the substance of earlier contri butions by the author, now restated, sometime further developed, and shaped into a coheren scheme. All igneous rocks are conceived as bein evolved from a normal basaltic magma, differentia tion being effected by fractional crystallisation an 'crystal sorting', modified by the intervention o resorption (the 'reaction principle'). The course o evolution may, however, be varied, according as th theoretical fractionation and resorption are actuall effective; and such variation should therefor stand in relation with the rate of cooling, and s with the size of the individual masses.

Since crystal sorting may alter to any extent th relative proportions of crystals and liquid, mos igneous rocks do not correspond in compositio with any liquid, actual or possible, and the clue t evolution is to be sought therefore in the 'liqui lines of descent', not in a simple comparison o bulk-analyses of rocks. Ultrabasic rocks, it is held can originate only by crystal sorting carried to th extreme. The conditions under which a mas mainly composed of crystals can figure as an intru sion are discussed and illustrated by reference to th peridotite dykes of Skye, which are made the sub ject of a new and interesting study.

In his instructive discussion of 'assimilation', th author seems to undervalue the importance of th

natural check imposed on this process. A surface of country-rock exposed to an igneous magma must soon become protected by a shield composed of minerals which are in equilibrium with the magma. Most of the results set forth in this part of the book will, however, receive at least a general assent from most petrologists, always excepting irreconcilable advocates of liquation.

The second part, dealing with a variety of subjects, is confessedly of a more speculative character. Of chief interest perhaps is a chapter on the possible manner of origin of certain alkaline rocks. Here it is shown, by the aid of diagrams partly conjectural in their details, how the crystallisation and subsequent resorption of leucite may give rise to residual magmas rich in potash. Much, too, is made to depend upon the rather precarious assumption that the pair anorthite-orthoclase belongs to Roozeboom's type 5 of solid solution. In support of this, the author cites the occasional presence of orthoclase borders round calcic felspars; but he ignores the much more frequent borders round sodic felspars, where the reaction-relation is certainly inadmissible.

The book is well arranged and well printed. It will provide the student with a much-needed guide to the generally accepted principles of petrogenesis; while doctrines which must be regarded as still on their trial are put forward with due reserve and lucidly presented. A. H.

Our Bookshelf.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 7, Teil 1: *Krystallographische und strukturtheoretische Grundbegriffe.* Von Prof. P. Niggli. Pp. xii + 317. 32·50 gold marks. Band 7, Teil 2: *Strukturbestimmung mit Röntgeninterferenzen*, von Dr. H. Ott; *Gittertheorie der festen Körper*, von Prof. Dr. K. F. Herzfeld. Pp. xiii + 433. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.)

PROF. NIGGLI of Zurich, formerly a colleague of Prof. Laue of Munich, is well known as the author of a comprehensive text-book of mineralogy, the second edition of which was recently reviewed in NATURE (vol. 119, p. 595; 1927). This new work forms the first part of the volume on crystallography in the "Handbuch der Experimentalphysik", and deals with the formal and mathematical study of crystal structure. The originality of the author is shown in his theoretical treatment of crystal symmetry, which contains a number of new methods and points of view. He states that his aim has been to elucidate the fundamental principles and to make the theoretical study of the subject practically useful. Although it was not possible to develop in full detail all the mathematical formulæ and relations, valuable tables are included embodying the most important results, and a word of special praise must be given to the numerous diagrams. Each chapter is provided with a short bibliography of the relevant literature, the older papers receiving special attention. The work should be of service both to the student and to the teacher of crystallography.

A new area in the study of crystal structure commenced in 1912 when Prof. Laue and his fellow-workers in the University of Munich were successful in using a crystal as a three-dimensional diffraction grating for X-rays. It is fitting that a member of the same university, Dr. H. Ott, should have been chosen to write the article on the theory and practice of this method of crystal analysis which forms Part 2 of the new volume of the "Handbuch der Experimentalphysik". He has himself done good work in this important branch of physics, including the construction of a metal and glass X-ray tube, the components of which can be exchanged rapidly without the necessity of cementing operations. In about three hundred pages he gives an excellent account of the theory of the method and a description of the most recent technique. Some of the reproductions of X-ray photographs obtained by various methods are amongst the most striking we have seen, and special mention may be made of the so-called Schiebold-Polyani diagrams (*Schichtliniendiagramme*). There are also good reproductions of photographs of models showing the arrangement of the atoms in various elements and compounds. The final article in this volume is an account by Dr. Herzfeld of the theory of the space-lattice of solid bodies to which Born has made such important contributions. H. S. A.

Amateur Telescope Making. Albert G. Ingalls, Editor. With Contributions by Russell W. Porter, Prof. Charles S. Hastings, Rev. William F. A. Ellison, Dr. George Ellery Hale, Dr. Elihu Thomson, Clarendon Ions, John M. Pierce, A. W. Everest. Pp. xii + 285. (New York: *Scientific American* Publishing Co., 1928.) 3.25 dollars.

THREE A.M. and still at it! The amateur telescope maker is represented in the frontispiece of this homely and amusing but thoroughly practical symposium as entirely absorbed in the parabolising of his mirror. When the present exclusive craze for 'wireless' has moderated, those in search of a new hobby would do well to buy this book and read it.

Ellison's "Amateur's Telescope" has long been known as almost the only practical book in English on astronomical mirror making and testing; it is valued alike by amateurs and professional opticians and has been largely reprinted in the volume now under review. In addition, there are articles and illustrations by American astronomers, opticians, and amateurs, including Prof. Charles S. Hastings of Yale and Dr. Hale of Mount Wilson; Dr. Elihu Thomson and Prof. G. W. Ritchey contribute to a miscellany of hints and suggestions.

The usefulness of Ellison's work will be considerably extended by the extra sections of the book,

especially Part I. by Russell W. Porter, which describes various mountings for amateurs' use and gives many practical details of glass working, including the making of optical flats and eyepieces. The book may, perhaps, give the impression that a great deal of optical work is somewhat easier than it really is. The fortunate learners are those who can have the guidance of an experienced worker in their early efforts, but the clear sketches and diagrams will make the way as smooth as it can be made for those who must venture alone. They will be left in no doubt as to the details of tests like the Foucault knife-edge test, and will be well guided with up-to-date information on figuring and abrasives. We think that even professional opticians may find this a handy book for reference on such points as silvering and the like.

Artificial Silk. By Prof. Dr. Franz Reinthaler. Enlarged and revised edition translated from the German by Prof. F. M. Rowe. Pp. xii + 276 + 45 plates. (London: Chapman and Hall, Ltd., 1928.) 21*s.* net.

PROF. ROWE'S translation of "Die Kunstseide und andere seidenglänzende Fasern" represents a thorough revision and considerable extension of the original German work by Dr. Reinthaler, and is undoubtedly one of the best books on the subject.

In addition to a full account of the manufacture and properties of the better known types of artificial silk, it gives adequate descriptions of Lilienfeld's viscose, the various ether silks, and of such products as staple fibre, tape, and cloth-like fabrics made directly from cellulose solutions. The section on microscopy, which is illustrated by about thirty-five photomicrographs and several diagrams, is particularly interesting: but the rest of the chapter on the properties of artificial silks might perhaps have brought out more effectively the special advantages and disadvantages of the various types of artificial silk in relation to the natural fibres. Again, some sections in the chapter on the examination and testing of artificial silks are less exhaustive than might be expected from the practical importance of such examinations. Thus in the section on the determination of artificial silk in mixed fabrics, only one method applicable to mixtures of wool and artificial silk is described, and none applicable to fabrics containing real silk.

Of the 260 pages of text, twenty-nine pages are given to the dyeing of artificial silks, seventeen to its uses, and nine to the economic situation of the industry. The final chapter deals very briefly with wild silks, vegetable silks, and modified cottons.

The Forestry Question in Great Britain. By Prof. E. P. Stebbing. Pp. viii + 217. (London: John Lane, The Bodley Head, Ltd., 1928.) 7*s.* 6*d.* net.

THIS book has been written with the view of placing before the general public the present position of forestry and its bearing upon future timber supplies. The book is divided into two parts: (1) the case for the public; (2) the case for the forester. The first part begins with a chapter on historical matter concerning forestry, and is followed by an examination of questions such as public opinion on the forestry question; the soft wood timber supplies and industrial requirements; timber supplies of the countryside; the financial aspect of the forestry problem; protective woods, beauty spots, and playgrounds; etc. In the second part of the book the author deals with technical problems, different types of forests and the reasons for growing them; privately and publicly owned forests; the work of the Forestry Commission, including the present census of British woodlands, and many other interesting problems.

The author has succeeded in producing a book that can be read with profit by both technical and non-technical people, for the technical part is so worded that it can be clearly followed by those who have not made a study of forestry questions. From Prof. Stebbing's position as chief of the Department of Forestry at the University of Edinburgh, he is well able to write with authority upon the subject under review.

Beneath Tropic Seas: a Record of Diving among the Coral Reefs of Haiti. By Dr. William Beebe. Pp. xiii + 234 + 39 plates. (New York and London: G. P. Putnam's Sons, Ltd., 1928.) 15*s.* net.

THE use of the diving helmet, the glass-bottomed boat, and the under-water camera, has given new zest to the study of marine life, and the Haitian Expedition of the Department of Tropical Research of the New York Zoological Society could scarcely have chosen more promising ground for testing the value of a floating laboratory. The scientific results of the expedition are promised in due course, but in the meantime the Director has published this volume as a popular exposition of the methods and possibilities of a new line of investigation. It is picturesquely, if somewhat diffusely, written, and gives a fair impression of the varied interests of nearly five months' exploration in the sea and in the jungle. For the would-be explorer a series of useful appendices describes the equipment necessary, the apparatus and methods of submarine photography, and the cost of the expedition, which, including the schooner, outfit, and staff of nine for five months, amounted only to about £3000.

Social Psychology: the Psychology of Political Domination. By Prof. Carl Murchison. (The International University Series in Psychology.) Pp. x + 210. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1929.) 16*s.* net.

PROF. MURCHISON does not intend his book to be used as a text-book, though according to him it may be so used by those who "are not forced to lead the life of formal quizmasters". He is worried by the barrenness of much of so-called social psychology and has attempted to make it more concrete. He considers in turn diverse subjects such as birth-control, community justice, the social contract theory, socialism, anarchy, democracy, and others, from their psychological aspects. His treatment, however, is too slight to be of substantial value.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Ore-lead and Rock-lead and the Origin of certain Ore Deposits.

IN an earlier communication to NATURE (April 3, 1926, p. 482), I attempted to show that of the lead dispersed through igneous rocks, roughly one-half is of radioactive origin. The atomic weight of the lead of radioactive origin can be evaluated from the proportions of uranium and thorium in rocks, taking the rate of generation of lead by thorium as 0·38 times its rate of production by uranium. The following table (compiled mainly from determinations by Joly and his collaborators) covers a sufficiently wide and representative range of data for our purpose.

Type of Rock.	Uranium × 10^6 gm./gm. of Rock.	Thorium × 10^6 gm./gm. of Rock.	Th/U.
Peridotites . .	1·50	3·3	2·2
Plateau basalts .	2·25	5·1	2·3
Oceanic basalts .	3·45	6·6	1·6
Eclogites . .	0·99	1·8	1·8
Diorites and Andesites . .	5·1	9·0	1·8
'Intermediate' rocks . .	7·6	16·4	2·2
Granites . .	9·0	20·0	2·2

Adopting the value Th/U = 2·2, the mixture of lead isotopes freshly generated (54·4 per cent of 206 and 45·6 per cent of 208) would have an atomic weight of 206·91; and, since the ratio Th/U does not vary much, the mixture would be about the same for all common rocks. If we take 'uranium'-lead as 97 per cent 206·016 and 3 per cent 207·016, thus allowing for the packing effect and the presence of actinium-lead, its effectual atomic weight is found to be 206·046 (agreeing closely with several good determinations of lead from uraninites); and the mixture, with thorium-lead taken as 208·016, now becomes 206·94. Since uranium disintegrates more rapidly than thorium, the ratio Th/U must have been lower in the past than it is to-day. 1600 million years ago, for example, the value corresponding to 2·2 would have been about 1·9, and the lead then generated would have had an atomic weight of about 206·8. Thus the average lead produced and accumulated in rocks during the earth's geological history cannot have an atomic weight higher than 206·9.

In striking contrast with this result we find that the atomic weight of ore-lead from such ores as galena and cerussite never differs significantly from 207·2. The most reliable recent determinations are listed in the accompanying table.

The series 2-8 in the table is of special interest in proving that the atomic weight is independent of the period of mineralisation. If the Tertiary ore-lead be a mixture of original lead and generated lead in proportions giving a resultant atomic weight of 207·21, then obviously the others, and especially the Pre-Cambrian lead, should have had an appreciably higher atomic weight, since the proportion of generated lead was then very much smaller. It is therefore reasonably certain, if the data be representative, that no appreciable part of ordinary lead can have been derived from the radioactive elements during their terrestrial history. It follows from these results that from whatever part of the earth's interior ore-lead may have come, it must have lain in an environment where it was unaffected by radioactively generated lead. This conclusion provides additional evidence in favour of the well-supported hypothesis that within the earth the proportions of uranium and thorium fall off until they become negligible. It is also in accordance with Prof. V. M. Goldschmidt's hypothesis of the existence beneath the silicate shells of a zone which is characterised by its relative richness in metallic sulphides (NATURE, July 6, 1929, p. 15).

Source of Lead.	Atomic Weight.	Analysts and References.
1. Commercial Nitrate	207·22	Baxter and Grover, *J. Am. Chem. Soc.*, 1915, p. 1027
2. Cerussite, N.S.W. (Pre-Cambrian)	207·22	
3. Cerussite, Eifel (Carboniferous)	207·20	
4. Galena, Nassau (Carboniferous)	207·21	
5. Galena, Joplin, U.S.A. (Post Carboniferous)	207·22	
6. Cerussite, Idaho, U.S.A. (Tertiary)	207·21	
7. Galena, Wash., U.S.A. (Tertiary)	207·21	
8. Vanadinite and Wulfenite, Arizona, U.S.A. (Tertiary)	207·21	
9. Galena, U.S.A. .	207·18	Richards and Wadsworth, *ibid.*, 1916, p. 2613
10. Common lead .	207·187	Richards and Hall, *ibid.*, 1917, p. 537
11. Common lead .	207·184	Richards and Sameshima, *ibid.*, 1920, p. 928
12. Common lead .	207·18	Richards and Putzeys, *ibid.*, 1923, p. 2956
13. Common lead (Distillation fractions)	207·23	Hönigschmid and Steinheil, Berlin, *Ber.*, 56B, 1923, p. 1831
14. Common lead .	207·19	Piutti and Migliacci, *Gazz. chem. ital.*, 1924, p. 605
15. Common lead .	207·22	Gleditsch, Dorenfeldt and Berg., *J. Chem. Phys.*, 1925, p. 253
16. Common lead .	207·21	Richards, King, and Hall, *J. Am. Chem. Soc.*, 1926, p. 1530

Now, since the atomic weight of ore-lead is 207·2, and that of the lead generated within the rocks is 206·9, it follows that rock-lead, being on an average a mixture of these in equal parts, should have an atomic weight of about 207·05. In the course of a thorough search for atomic weight data bearing on the above argument, I have found a determination which seems to substantiate it. In 1923 Piutti and Migliacci determined the atomic weight of lead from the sublimate mineral, cotunnite (lead chloride), which originated during the 1906 eruption of Vesuvius (*Att. R. Accad. Lincei*, **32** (1), 468-472; 1923; and *Gazz. chem. ital.*, **54**, 605-610; 1924). Their results ranged from 207·025 to 207·079, and gave a mean value of 207·05.

For ordinary lead, as listed in the above table, their mean value was 207·19; and the difference has hitherto not been explained.

The lead in cotunnite was emitted as chloride with the catastrophic outbursts of gases that characterised the 1906 eruption. Before the eruption it must, therefore, have been dispersed through the magma responsible for the activities of Vesuvius. This particular lead can thus be justly claimed as a genuine sample of rock-lead, and the apparently abnormal value of its atomic weight can now be adequately accounted for, as it is exactly what the value for average rock-lead should be, 207·05.

Too much weight must not be given to the exact numerical coincidence, for the Vesuvius magma is a differentiated type, and we are still in ignorance as to the nature of the parent magma of which it is a residual. The parent magma may, or may not, have represented an average kind of rock-substance. The significant point is rather that for all rocks, and therefore for all corresponding rock-magmas, the atomic weight of the contained lead should lie between 206·9 and 207·2. By the case cited the validity of the deduction is established. It is to be hoped that additional atomic weight determinations will be made on lead from cotunnite and associated basic chlorides of lead occurring in other volcanic centres where the magma types are of a less specialised composition.

In the light of the very cogent evidence that has been presented, the inference can no longer be evaded that the lead of ore-bodies such as those in which galena commonly occurs cannot have been derived from the magmas of igneous rocks. Moreover, if this be true of lead, it is only reasonable to regard it as equally true of the associated sulphide-minerals, including those of silver, zinc, copper, and iron. Thus we are led to agree with Prof. J. W. Gregory—at least for certain deposits—that "the source of the ores appears to lie in a zone deeper than that of the ordinary igneous rocks" ("Economic Geology", London, 1928, p. 19). In this connexion it may be significant that in several outstanding provinces of lead-zinc deposits (for example, Pennines, Mississippi Valley, and western Transvaal) a most perplexing feature has been the failure to discover any exposures of igneous rocks with which the ores could be correlated. Prof. Gregory's hypothesis of the origin of certain ore-deposits—first published in 1906 (*Trans. R. Inst.*, 1906, p. 9)—is thus by no means inconsistent with geological observations, though it has generally been regarded as a heresy. It is nevertheless a remarkable tribute to the solidarity of science that it should first receive unequivocal support from a source so apparently unrelated as that of atomic weight determinations.

ARTHUR HOLMES.

The University,
Durham, Sept. 3.

Compressibility of Crystals.

IN NATURE of Mar. 23, 1929, p. 448, N. Rashevsky calls into question the experimentally determined values for the compressibility coefficient. He points out that there is good evidence that sub-microscopic cracks depress the true tensile strength of materials to small values, and suggests that these cracks may likewise lead to compressibility coefficients much greater than the true coefficients, which in fact may be zero. In an attempt to estimate the volume of these cracks, he concludes that possibly several per cent of the volume of crystals is void. Since the total volume change over a range of 10,000 atmospheres is ordinarily only a few per cent, he reasons that "it is not impossible that practically the whole change of the volume is due to the decrease of the size of the cracks".

To workers in this field this suggestion is so severely iconoclastic that it should be very thoroughly examined, especially, as Rashevsky points out, since the compressibility coefficient is basic in the calculation of the exponents of the repulsive forces (or potentials) in crystals. It is the purpose of this communication to attempt to show the genuineness of the compressibility coefficient, under two headings: (1) Internal evidence from the inter-relationships of the generally accepted compressibility coefficients among themselves and with other physical properties; (2) possible volume of internal voids.

(1) The atomic volume curve of the elements (arranged according to atomic number) is very distinctly a periodic property, clearly not dependent for its periodicity upon crack formation. The compressibility curve parallels the atomic volume curve with remarkable fidelity (as shown first by Prof. T. W. Richards, *Carnegie Institution Publication*, No. 76, 1907, p. 66, but more completely later by the same author, *Jour. Frank. Inst.*, July 1924, p. 9), the alkali metals on each curve appearing at the summits of sharp peaks, but even more convincing, the small and scarcely perceptible peaks at zinc and cadmium, respectively, on the atomic volume curve appearing faithfully on the compressibility curve. Sections of this curve show a surprising parallelism, as that which includes the elements tin, antimony, tellurium, iodine, and cæsium (R. F. Mehl and B. J. Mair, *Jour. Amer. Chem. Soc.*, **49**, 1897; 1927). The atomic volumes of tin, antimony, and tellurium are, respectively, 16·2, 18·2, and 20·4. This increase is reflected in the compressibility coefficients, $1{\cdot}9 \times 10^{-6}$, $2{\cdot}4 \times 10^{-6}$, and $5{\cdot}0 \times 10^{-6}$. If it be admitted that the periodicity in the atomic volume be legitimate, it will be difficult to escape the conclusion that these compressibility coefficients are likewise legitimate.

If it is assumed that the entire or major portion of the volume decrease on pressure increase is caused by the presence of voids, it becomes difficult to understand the compressibility of such elements as tellurium, iodine, sodium, and cæsium (to choose only a few), which have initial compressibilities varying from $5{\cdot}0 \times 10^{-6}$ (tellurium) to $61{\cdot}0 \times 10^{-6}$ (cæsium), and would contract in volume under a pressure of 10,000 atmospheres to the extent of 4 per cent (tellurium), correcting for the pressure coefficient of compressibility, and 50-60 per cent (cæsium), allowing for the pressure coefficient which is not known. It can scarcely be held that the volume of the cracks can amount to so much as 50 per cent in cæsium, and with the admission of a valid and high compressibility coefficient for this element, it is difficult to deny smaller but none the less valid coefficients to the other elements in the face of the numerous and comprehensible inter-relationships which the compressibility coefficient exhibits with many other physical properties.

In addition, the heats of formation of the oxides and the chlorides of the metals parallel the compressibilities of these metals (T. W. Richards, *Smithsonian Report*, 1911, pp. 199-215), and the reciprocals of the absolute melting-points likewise closely parallel the compressibilities. It is not reasonable to assume that the heats of formation of compounds, or the melting-points of the pure metals, are in any way conditioned by the presence of cracks.

In general, it must be admitted that the many and varied inter-relationships between the compressibility coefficients as they are generally accepted and the various physical and chemical properties of the elements are presumptive evidence of common controlling

basic factors, and therefore testify to the validity of those coefficients.

(2) Rashevsky's approximation for the volume of the internal cracks is several per cent of the total volume. Direct experimental evidence can be quoted against this approximation, namely, the close agreement between the lattice constants calculated from density measurements and those measured directly by the diffraction of X-rays. Until the work of Bearden (*Proc. Nat. Acad. Sci.*, **15**, 6; June 1929) such a test could not be performed, since the lattice constant of calcite was calculated directly from the density and then used as a unit for the measurement of X-ray wave-length. It could then have been argued that calcite crystals (and other crystals) actually contain voids leading to erroneous measurements of X-ray wave-lengths. Bearden, however, has measured the wave-lengths of copper $K\alpha$ and $K\beta$ directly by diffraction from an optical grating. His results are shown in the accompanying table and compared with the measurements of Siegbahn based on the accepted lattice constant of calcite :

	$K\alpha$.	$K\beta$.	Probable Error.
Bearden . . .	1·5422	1·3926	±0·0002
Siegbahn . . .	1·5386	1·3893	±0·0005
Difference . .	0·0036	0·0033	±0·0007

It is true that there is an unexplained numerical discrepancy of 0·23 per cent between the two results, but it is of the wrong sign to be accounted for by the presence of internal cracks. That is, the presence of internal voids in calcite would lead to low density values and therefore to high values of the calculated lattice constant, which in turn would give erroneously high values for wave-length. A direct measurement of wave-length should then give lower wave-lengths, but the opposite is true.

It is scarcely pertinent to the present note to discuss the reasons which may be found to account for the discrepancy noted above—it is sufficient to point out that the data quoted in (2) cannot be reconciled with the existence of any internal voids whatsoever, but rather must be taken to signify exactly the opposite.

The above discussion does not, of course, question the reality of the surface cracks, for which there has been good experimental evidence supplied by Griffiths, Joffé, Kapitza, and Zwicky, and for which there are excellent theoretical grounds. No experimental evidence, however, has ever been presented in proof of internal cracks, and in fact the data given in (2) appear to preclude their existence. In addition, there are no theoretical considerations known, at least to us, requiring their existence. It seems certain, therefore, not only that solids have real compressibility coefficients, but also that the accepted values are very close indeed to the true values.

R. F. MEHL.
R. H. CANFIELD.

Division of Physical Metallurgy,
Naval Research Laboratory,
Washington, D.C.

Ice-bergs in a High Latitude.

THE occurrence of small ice-bergs in the northern part of the Greenland Sea—the strait between Greenland and Spitsbergen—and in the same situation, and also in a lower latitude off the Greenland coast of mud or alluvial matter on the surface of the drifting ice, are facts that appear worthy of attention.

Ice-bergs are not usually said to occur in the northern part of the Greenland Sea; Scoresby ("Arctic Regions", vol. 1, p. 104) comments on their rarity, while according to Nansen ("Hunting and Adventure in the Arctic", p. 37), "there are practically none in the whole Polar Sea". The log-books of the whaling vessels in my possession, however, prove that they do occur but are of small size, and only occur at intervals of years. For example, they are mentioned in a high latitude and at a distance from land in the log-books of both the *Eclipse* and *Hope* in 1876, in 1878, in 1883, and in 1887, but not in the intervening years.

Three of the entries in the *Eclipse's* log-book reads as follow : May 25, 1878, Lat. 79° 20′; Long. 4° 30′ east; "cruised about near the impenetrable ice; numbers of ice-bergs about, some of them had (evidently) been through a heavy sea having large lumps of (sea) ice washed up on top of them at least 12 feet above (sea) level". June 25, 1878, Lat. 79° 45′; Long. 6° east; "made (the ship) fast to an ice-berg and took fresh water ice on board". June 2, 1887, Lat. 79° 7′; Long. 2° 55′ east; "many ice-bergs in sight; seventeen being in sight from the mast-head (at one time) . . . (this year) they are equally numerous north as far as we have been" (Lat. 80° 10′).

The place of origin of these ice-bergs, a mystery in 1887, now seems to be the recently discovered Nicholas II. Land; at least, this is the conclusion I come to after reading Commander Transehe's account of its discovery (*Geographical Review*, vol. 15, p. 367). I was with my father in 1887, and can say that the ice-bergs we saw on June 2 in Lat. 79° are similar to those the Russians saw in 1913 aground near Nicholas II. Land. They were flat or table-topped and of very moderate size and height, and agree with Transehe's description. If this conclusion is correct, they probably drift north-east from Nicholas Land—parallel to the drift of the *Fram*—to a point north of Franz Joseph Land before they commence to drift south-west towards the Greenland Sea.

The fact that these small ice-bergs do not make their appearance in the northern part of the Greenland Sea every year may be due to the want of a sufficiently high tide to float them, and of a strong enough southerly wind to start them off on their long and circuitous voyage towards the sea.

Mud or alluvial matter is now well known to occur on the surface of the ice that drifts south through the Greenland Sea, but the actual finding of it does not appear to have been described. The following references to it in the log-books of the whalers may therefore prove of interest.

Log of *Eclipse*; Aug. 1, 1876, Lat. 68° 54′; Long. 20° west; "having now left the ice it will be proper to mention here that during our search for whales we have sailed amongst the ice from Lat. 80° 10′ Long. 5° east to Lat. 68° 40′ Long. 22° west, and throughout the whole of this distance much of the ice (estimated at a third) was covered more or less with a light greyish looking mud, much dispersed, and also (in places) with dark red mud, but not in such quantity. It (the latter) was always in solitary pieces by itself. From its (the mud's) appearance I (at first) thought it must have been thrown up by a volcano, but having taken a sample on board and washed it, I found it to contain a vast number of marine shells, (particles of) mica, and fine sand." Log-book of *Hope*; July 15, 1879, Lat. 78° 40′; Long. 1° 30′ west; "came to a large mound of earth of a brownish hue. . . . Its weight was (estimated to be) about 60 tons; brought some on board; found it consisting of sand and shells"; and on the fly-leaf of the log-book (a

meteorological one): "the mound of earth I fell in with on July 15th was on the ice. . . . There were numerous birds sitting on. There were also a few eggs."

The mud referred to in the whaling ships' log-books was on the surface of the ice under the snow and consequently not visible until the latter melted. A sample I collected in 1887 and showed to the late Sir John Murray, as stated in the *Zoologist*, p. 104, 1889, consisted mostly of minute particles of quartz, mica, etc., the whole, when collected and allowed to dry, cohering into a yellowish brown clay.

Like the tree trunks, mentioned in the log-books, found sometimes frozen into the ice, sometimes floating in the water, the mud obviously came from the Lena and other rivers emptying into the Arctic Ocean, but why it occurred on the surface of the ice was, in 1887, hard to understand. The explanation, which Prof. Gregory of Glasgow has kindly furnished me with, is, however, simple enough; the particles of quartz, etc., at one time suspended in the water, are incorporated in the ice when the sea freezes and, since three or four years may elapse before the ice enters the Greenland Sea, and in this period its upper surface melts in summer and its under surface is added to in winter, the particles of mineral matter rise and eventually form a layer on the top of the ice.

The quantity of mineral matter that gets transported in this way in the course of years, to be deposited eventually on the floor of the ocean far from its place of origin, seems to be much greater than is generally supposed.

ROBERT W. GRAY.

8 Hartley Road,
Exmouth, July 18.

The CH-Band at λ3143 and a New NH-Band at λ2530.

WITH a condensed spark discharge (10-40 thousand volts transformer with two Minos-jars of 4000 cm. capacity each) between tungsten and carbon electrodes 1 cm. apart in an atmosphere of hydrogen at about 7-10 cm. pressure as a source, a system of CH-bands is observed. The band with its intensity maximum at λ3143, originally reported by Fortrat (*C.R.*, **178**, 1272; 1924), appears with strong intensity together with the well-known bands at λ3900 and λ4300. The measurement of the wave-lengths, though not very accurate, and the analysis of the band have been carried out using the spectrogram taken with a Hilger quartz spectrograph E2. Fig. 1 gives the diagrammatical view of the band.

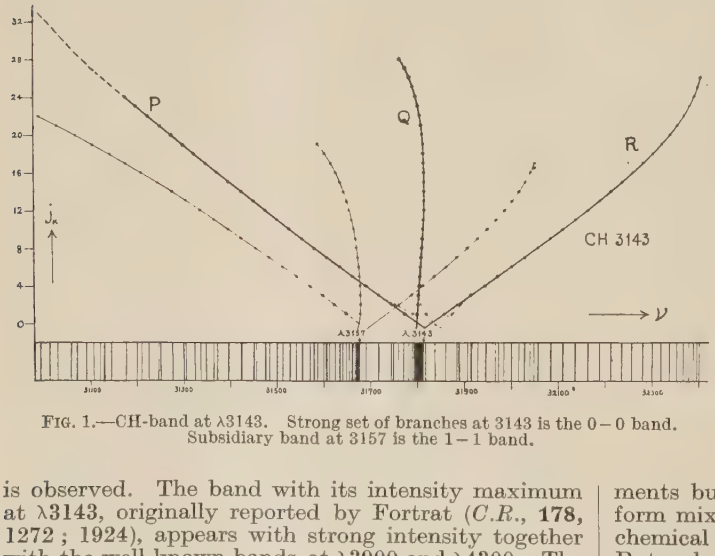

FIG. 1.—CH-band at λ3143. Strong set of branches at 3143 is the 0 – 0 band. Subsidiary band at 3157 is the 1 – 1 band.

From the general characteristics of the band, it is suggested that it belongs to a $^2\Sigma \longrightarrow {}^2\Pi$ system. In fact, it has a common final level $^2\Pi$ with the bands at λλ3900, 4300, since the combination differences $R(j_k) - P(j_k + 2)$ just coincide with those calculated by Kratzer from the data of the other two bands (*Zs. f. Phys.*, **23**, 298; 1924; cf. also Mulliken, *Phys. Rev.*, **30**, 781; 1927). The upper rotational levels as calculated from the $R(j_k) - P(j_k)$ differences are approximately given by

$$F'(j_k) = 14{\cdot}24_3 j_k(j_k + 1) - 1{\cdot}531_5 \times 10^{-3} j_k^2(j_k + 1)^2 \quad (j_k = 0, 1, 2, \ldots),$$

as it should be for a $^2\Sigma$ term. The doublet structure of the branches, which manifests itself near the origin, gives the approximate measure of the doublet spacing $^2\Pi_{\frac{3}{2}} - {}^2\Pi_{\frac{1}{2}}$. It is again coincident with the values calculated from the formula for the $^2\Pi$-terms:

$$F''(j) = 14{\cdot}2071(\sqrt{(j + \tfrac{1}{2})^2 - \sigma^2} - \rho) - 1{\cdot}4465 \times 10^{-3}(\sqrt{(j + \tfrac{1}{2})^2 - \sigma^2} - \rho),$$

where $\sigma = 1$ and $j = j_k + \frac{1}{2}$, $\rho = \frac{1}{2}$ for $^2\Pi_{\frac{3}{2}}$ term, $j = j_k - \frac{1}{2}$, $\rho = -\frac{1}{2}$ for $^2\Pi_{\frac{1}{2}}$ term (Kratzer, loc. cit., p. 306). Moreover, the σ-type doubling in the $^2\Pi$ state gives rise to a 'combination defect' in the Q-branch, which is actually observed and can well be accounted for by assuming the numerical values given by Kratzer (loc. cit., cf. Table 21). Further evidence is supplied by the study of the missing lines and relative intensities at the beginning of the branches. These are all in accordance with the theory. The nuclear distance in the $^2\Sigma$ state is $r_0' = 1{\cdot}12 \times 10^{-8}$ cm.

With the same type of discharge and a lithium electrode to avoid the contamination of the spectrum due to the tungsten lines—any other element like potassium, which has a small ionisation potential and few lines in the spectrum, answers the same purpose—in a mixture of nitrogen and hydrogen gases at about 5 cm. partial pressure, a new simple band at λ2530 has been obtained. Its intensity is feeble in comparison with the NH-band at λ3360, which appears with an abnormally great intensity together with the N_2-bands. Nevertheless, the analysis could be carried out with ease, which shows that its emitter is the NH-dipole and the corresponding transition is of $^1\Sigma \longrightarrow {}^1\Pi$ type. The nuclear separation of the molecule in its initial and final states are $r_0' = 1{\cdot}03 \times 10^{-8}$ cm. and $r_0'' = 1{\cdot}06 \times 10^{-8}$ cm. respectively. Details will be published elsewhere.

TAKEO HORI.
Port Arthur College of Engineering,
South Manchuria, Japan.

Isomorphism and Homology.

IT is well known that the law of isomorphism discovered by Mitscherlich is now accepted with considerable limitations. Marignac, for example, showed long ago that the compounds $ZnTiF_6, 6H_2O$, $ZnCbOF_5, 6H_2O$, $ZnWO_2F_4, 6H_2O$, though homomorphous and capable of forming mixed crystals, are not identical in chemical formulæ. It is to be assumed that there are not only homologous elements but also homologous radicals. The ability to form mixed crystals, homomorphism, and identity of chemical formulæ are not necessarily co-existent. But when certain elements or radicals can be substituted totally or partially in very different salts, the analogy of these elements or radicals remains undisputable and makes legitimate the parallelism of chemical formulæ.

Dr. Pulin Behary Sarkar, working in the Inorganic

Department of this Laboratory, has been studying the relationship of chemical homology and mixed crystallisation, and starting from Langmuir's theory of 'octets', came to the conclusion that isoelectric isosteres should exhibit close relationship in chemical and physical properties.

Transport experiments showed that the so-called double fluorides of beryllium and ammonium or potassium are really complex salts having BeF_4 as a bivalent anion, though partially dissociated into Be^{++} and $4F^-$. BeF_4^{--} is isosteric and isoelectric with SO_4^{--}, having 5 atoms and 32 peripheral electrons, the covalences of beryllium and sulphur being 4 in each case. Molecular volumes of $(NH_4)_2BeF_4$, $(NH_4)_2SO_4$, K_2BeF_4, and K_2SO_4 are found to be very closely alike. They form mixed crystals in all proportions. Further, the constituent ions, namely, S^{++++++} and Be^{++}, as well as O^{--} and F^-, have identical ionic radii as determined by v. Goldschmidt.

Regarding mixed crystallisation of two chemical species, which entails equality of molecular coefficients, thermal and elastic, as the best criterion of chemical analogy, Dr. Sarkar has prepared the following double salts: K_2BeF_4, $NiSO_4$, $6H_2O$; K_2BeF_4, $ZnSO_4$, $6H_2O$; K_2BeF_4, $CoSO_4$, $6H_2O$; K_2BeF_4, $CuSO_4$, $6H_2O$, which are monoclinic and isomorphous with the well-known double sulphates of potassium and those of the magnesium family of elements studied by Locke. Curiously enough, potassium sulphate forms only the above four double salts, whereas with the double fluoride of ammonium and beryllium, Am_2BeF_4, the following isomorphous double salts have been prepared by Dr. Sarkar:

Am_2BeF_4, $NiSO_4$, $6H_2O$	Am_2BeF_4, $FeSO_4$, $6H_2O$
Am_2BeF_4, $CoSO_4$, $6H_2O$	Am_2BeF_4, $MnSO_4$, $6H_2O$
Am_2BeF_4, $ZnSO_4$, $6H_2O$	Am_2BeF_4, $MgSO_4$, $6H_2O$
	Am_2BeF_4, $CdSO_4$, $6H_2O$

Here also the only missing one is that of copper, as was observed by Locke with Am_2SO_4.

In the above examples, BeF_4^{--} has partially replaced SO_4^{--}. Dr. Sarkar has also succeeded in isolating a series of double salts in which SO_4 ions have been completely replaced; for example, Am_2BeF_4, $NiBeF_4$, $6H_2O$, perfectly isomorphous with the aforesaid series. Further corroborative evidence of the analogy is afforded by the preparation of the following alums: Am_2BeF_4, $Al_2(SO_4)_3$, $24H_2O$, and Am_2BeF_4, $Fe_2(SO_4)_3$, $24H_2O$.

By fusion of barium chloride with Am_2BeF_4, Dr. Sarkar has isolated crystalline $BaBeF_4$ corresponding to crystalline $BaSO_4$. The crystallographic constants of the double salts are found to be very close to those of the double sulphates studied by Tutton.

A detailed account of the investigation will appear in a forthcoming issue of the *Journal of the Indian Chemical Society*.

P. C. RÂY.

Department of Chemistry,
University College of Science
and Technology,
Calcutta, Aug. 8.

Origin of Nor'westers.

DURING spring and summer Bengal is occasionally visited by a type of severe thunderstorms locally known as the *Kal-Baisakhi*, or the 'fateful thing' of the month of *Baisakh* (April 15–May 15). These storms usually approach a station from the northwest and burst suddenly with great fury. The path of a nor'wester may vary in width from a few hundred feet to a mile, and the distance overrun seldom exceeds 10 miles. These storms are more frequent in the late afternoon, although they are known to occur also at other times of the day. A nor'wester is always associated with a thunder-shower, and the precursory signs of its approach are the same as those which herald the coming of a violent thunderstorm.

During last summer one of us (G. Chatterji) led an expedition to south Bengal to study the upper air conditions associated with nor'westers. On three occasions it was possible to collect some information from soundings by Dines and Chatterji meteorographs. A typical height-temperature graph obtained on one occasion just before the passage of a storm is reproduced in Fig. 1. It appears that the nor'wester type of thunderstorms originates through the overrunning of a warm moist southerly or south-westerly wind by

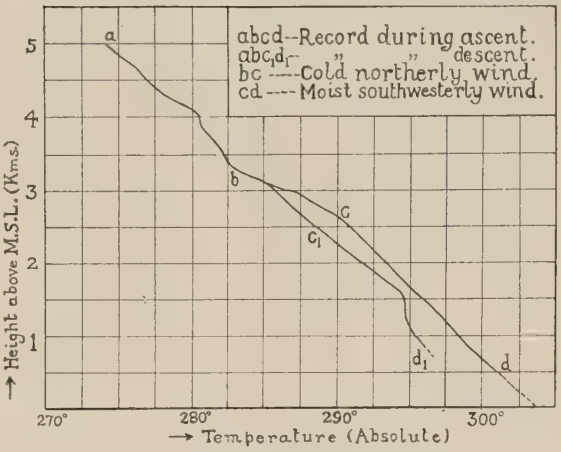

FIG. 1.—Upper air soundings over Jhikargacha, Bengal, on May 17, 1929, at 17 hr. 35 m. I.S.T., just before a nor'wester.

a westerly or north-westerly cold air with a high lapse rate. In the present case the cold air overran the moist air at 2·7 km. and extended to 3·3 km. The air in this layer had a superadiabatic lapse rate of 12° C. per km. while the air underneath was almost saturated and had a lapse rate of 5° C. per km. On all the three occasions the 'overrunning' took place in the south-eastern quadrant of a low pressure area which developed a 'wind-shift line' more or less defined.

Thus the general conditions under which nor'westers occur in Bengal appear to be exactly similar to those giving rise to 'tornadic' thunderstorms in the Mississippi Valley of the United States of America (Humphreys, "Physics of the Air", p. 344). Upper air soundings on nor'wester days show that there is a marked increase in the absolute humidity of the southerly current from the Bay of Bengal in the afternoon. This probably explains why the nor'wester type of thunderstorms is more frequent during the afternoon that at any other hour of the day.

S. C. ROY.
G. CHATTERJI.

Meteorological Office,
Ganeshkhind Road,
Poona, India, July 26.

Control of Diseases and Weeds in a Forest Nursery.

SINCE 1920 seedling diseases caused by *Corticium Solani* Bourd. and Galz. and *Botrytis* sp. have done considerable damage in the Ministry of Agriculture's forest nursery at Baronscourt, County Tyrone. The attack has involved the two species Sitka spruce (*Picea Sitchensis* Carrière) and Douglas fir (*Pseudotsuga Douglasii* Carrière).

In an attempt to eradicate the trouble, an exhaustive series of trials have been carried out with soil fungicides, including sulphuric acid, Cheshunt compound, formaldehyde, mercuric chloride, and cresylic acid. The most satisfactory results were obtained by using sulphuric acid (1 in 80) applied to the soil on the same day as the seeds were sown. Cheshunt compound did not prove to be nearly so valuable as a fungicide for this particular purpose, although when applied to growing seedlings it exerted a distinct manurial effect and stimulated growth. Formaldehyde, mercuric chloride, and cresylic acid did not give results which could be compared with those obtained by using sulphuric acid.

The application of sulphuric acid at sowing time also greatly controlled the growth of weeds, and the cost of weeding the seed beds has been reduced by fifty per cent through its use, after allowing for the cost of the acid and of its application. The blow-lamp method recommended for weed control by Messrs. Benjamin Reid of Aberdeen has not given such good results under conditions obtaining in Northern Ireland.

Sulphuric acid as a fungicide and weedicide has given equally good results when used on a large scale, and the treatment is now included in the routine of raising conifer seedlings in the forest nurseries of the Ministry. Up to the present, no adverse effect on the soil has been experienced by the application of the acid.

It is expected that a full account of the work which has been carried out will appear in volume 3 of the *Journal* of the Ministry of Agriculture for Northern Ireland, to be published in 1930.

ARTHUR E. MUSKETT.

Department of Agricultural Botany,
Queen's University,
Belfast.

The Frenkel Adsorption Isotherm.

DURING an investigation into the temperature coefficient of the adsorption maximum of gases on a solid surface, we have had occasion to examine the Frenkel adsorption isotherm. This is written (*Zeit. f. Phys.*, **26**, 133 ; 1924, equation 9a) :

$$\frac{S}{n} = \sigma_0\left(1 + \frac{\sqrt{2\pi mkT}}{p\sigma_0\tau_0}\right)e^{-u_0/kT}$$

Frenkel deduces from this equation that at sufficiently low values of T the number of adsorbed molecules, n, approximates to a maximum value S/σ_0. It is difficult to see how this result is obtained. When p is very large this isotherm gives at the saturation maximum a value of n which approximates to $\frac{S}{\sigma_0} \cdot e^{u_0/kT}$, and it is therefore at high temperatures and not low that n approaches S/σ_0. Moreover, the existence of a marked temperature coefficient in the value of the adsorption maximum is very surprising, for the Langmuir isotherm which was developed from almost identical assumptions and using the same method has not this temperature coefficient.

A closer examination of the equation has explained the discrepancy, for it appears that Frenkel has made a slight algebraic error in deducing the final equation. The corrected isotherm is

$$\frac{S}{n} = \sigma_0\left(1 + \frac{\sqrt{2\pi mkT}}{p\sigma_0\tau_0} \cdot e^{-u_0/kT}\right),$$

which gives the saturation maximum S/σ_0 which is independent of T.

F. J. WILKINS.
A. F. H. WARD.

Laboratory of Physical Chemistry,
Cambridge, Aug. 14.

Attempts to induce Rainfall.

THE Colony of Hong-Kong has suffered from an unprecedented deficiency in rainfall during the twelve months ending June 30, 1929, with consequent distress to the population, owing to water shortage.

Amongst the many suggestions received from the public by the local Government was the proposition that powdered kaolin, sprinkled from aeroplanes above suitable clouds, would induce precipitation ; the method was stated to have been employed with success in other countries. After discussion with other government officials, I made the following recommendation :—

"I consider that the experiment might reasonably be attempted once. I have little doubt of its failure, but this avenue of relief may then be considered sufficiently explored and be definitely closed thereafter."

My personal opinion is plainly expressed in the foregoing ; had the Government refused to countenance the experiment, however, there would have remained a feeling in the public mind that one possible solution of the water problem had not been tried. The experiment was made by the unit of the R.A.F. stationed here, and no precipitation occurred.

The reports in the local press are now being commented upon by journals outside the Colony, usually with the implication that this Observatory was responsible for the inception and conduct of the experiments. This was not the case ; the experiments were authorised by the Government to discount any subsequent criticism. No belief in a materially successful result was held by the administration or its advisers, including my colleagues and myself.

C. W. JEFFRIES
(Acting Director).

Royal Observatory,
Hong-Kong, July 31.

Dew : Does it Rise or Fall ?

I THINK it may be said to do both. There is no doubt, as Mr. John Aitken proved many years ago, that *real* dew rises as vapour from the ground and condenses on cold surfaces near the ground. This may be observed on plantain or dandelion leaves growing, for example, on a hard gravel path ; the hard material loses its heat slowly during the night and, though there is no visible condensation, moisture continues to rise. The leaves will radiate their heat after sundown from the upper surface and moisture will deposit on the under surface only. There are, of course, other ways of showing the same effect.

Another form of dew, which may be termed *false* dew, is caused by cold air, formed during radiation, flowing from a higher to a lower level. The cold air tends to cool the objects with which it is in contact and the water vapour present in the warmer air is thereby condensed. Mist over water and marshy ground is formed in this way and this dew may therefore be said to fall. Some years ago I was able to show that at the lake level at Coniston the temperature of the air in the early morning before sunrise was several degrees lower than at the top of the Coniston Old Man (2633 ft.), and whereas the grass was dripping with moisture at the foot of the mountain, that on the top was as dry as on a warm summer's day. The cold air had descended and been replaced by the warmer air from below.

J. B. COHEN.

Coniston.

Progress of the Discovery Investigations.[1]

By Dr. STANLEY KEMP.

SINCE the R.R.S. *Discovery* returned to England at the end of 1927, the oceanographic and whaling investigations which the Discovery Committee is conducting in the South Atlantic have been continued with the R.S.S. *William Scoresby* and at the Marine Biological Station in South Georgia.

R.S.S. *William Scoresby*.

The *William Scoresby* sailed from Cowes in the last week of 1927 with Mr. D. Dilwyn John in charge of the scientific work. The commencement of the voyage was marked by a tragedy, for two days after leaving port, in a heavy gale in the Bay of Biscay, leading seaman Sydney Cook was washed overboard and lost. During the previous commission he had proved himself a cheerful and willing member of the small ship's company, and his practical experience of trawling had been a valuable asset. Shortly before reaching the Falkland Islands the vessel met a number of fin whales and experiments were made in whale-marking. Eight hits were recorded, and it is believed that at least five whales were marked.

On Feb. 7 the *Scoresby* left for South Georgia, taking on the passage a line of seven stations, mostly in deep water, at which observations were made on plankton and hydrology. As in the previous season, icebergs were unusually numerous, and one of the stations was taken under the lee of a berg estimated to have a length of 50 miles. At South Georgia the vessel was engaged until Mar. 13 in repeating the survey of the planktonic and hydrological conditions on the whaling grounds. This survey was hindered by fog and the presence of ice, but 48 stations were taken, 21 consisting mainly of plankton observations and 27 with full hydrological observations in addition. With the view of testing the uniformity of the plankton distribution in the area, series of continuous hauls with plankton nets were made during the course of the survey. One series of hauls with surface nets was made, and two with oblique nets worked from 100 metres to the surface. The rather difficult technique involved in the latter operations owes much to the ingenuity of Mr. F. E. C. Davies, now acting chief officer of the vessel.

At the conclusion of the survey the *Scoresby* unfortunately touched a rock in the approaches to Stromness Harbour. This caused damage to the stern frame, and delayed resumption of work until April 14, when the whaling season was concluding. The whaling factories reported that pack-ice was closing in on the South Shetlands, and some of them had already left on the return voyage to Europe.

In these conditions it was not possible to complete the full programme. The *Scoresby* sailed from South Georgia on a south-westerly course and, after six deep-water stations had been taken, met pack-ice about 40 miles north of Clarence Island, the seventh station being worked in an open lane in the ice. The sea on this occasion was ominously calm and it became apparent that the vessel was sheltered by an extension of the pack lying to the north. During the night a south-west gale arose and the vessel succeeded with some difficulty in getting clear, with her decks and superstructure heavily coated with ice. So far as could be ascertained, the pack-ice formed an impenetrable barrier to further progress in a southerly direction, and a course was therefore set for the Falkland Islands. Seven further stations were taken, including three on the Burdwood Bank, and Port Stanley was reached on May 1. One night, when in the pack-ice, a number of fin whales came close up to the ship, apparently attracted by the lights on board; marking guns were brought into operation, and it is believed that six of the whales were marked. This passage was the most difficult that has been made during the investigations. Weather of exceptional severity was encountered throughout, and for eight days out of a total of seventeen the vessel was hove to.

During the winter season of 1928 the *William Scoresby* continued the trawling survey which had been begun in 1926 of the plateau round the Falkland Islands. About 38 trawling stations were taken over an area some 400 miles in length by 300 miles in breadth. During this work particular attention was paid to the edge of the continental slope, where it was thought that hake (the fish of greatest economic importance in the region) might occur plentifully. The results of this trawling survey cannot yet be definitely assessed. That they are not unpromising may be judged from the fact that in several areas hake were found in marketable quantities, though the season in which the operations have hitherto been conducted may be expected (on analogy with northern fisheries) to be the least productive.

In order to obtain some knowledge of the winter conditions on the whaling grounds, the *Scoresby* left Port Stanley for South Georgia on Aug. 19, repeating *en route* the series of stations taken earlier in the year. After arrival, though much interrupted by gales, fog, and snow, four lines of stations were completed and a further series of continuous surface nets was hauled.

Since the Discovery investigations began, the methods of operation of the whaling factories in the Dependencies have undergone a marked change. Four years ago these factory ships lay at anchor at Deception Island, or in other harbours in the South Shetlands, while their whale catchers worked in the neighbouring area. Recently, however, the factory ships have been taken along the edge of the pack, where the only shelter is that which the ice may afford; and since whales have been found in abundance, this more dangerous method of

[1] For previous accounts of the investigations see NATURE, Oct. 30, 1926, and May 19, 1928.

operation has become general. The area worked in this way extends across the mouth of the Weddell Sea from Elephant Island and the South Orkneys so far east as the South Sandwich Islands.

In September 1928 the *Scoresby* left South Georgia to observe conditions along the ice edge, but the first attempt, when pack-ice was found 120 miles east of the island, was rendered abortive

FIG. 1.—Chart illustrating the work carried out by the R.S.S. *William Scoresby* along the edge of the pack-ice to the east of South Georgia in September and October 1928.

by the onset of heavy weather. In the early days of October a line of stations was taken south-eastwards from Cooper Island, and continuing on an easterly course the pack was found in Lat. 55° 27′ S., Long. 32° 21′ W. With a westerly breeze the edge of the pack was often very sharply defined and frequently it was possible to make observations at its actual margin. The ice edge was followed in an easterly direction for several days, and as shown in Fig. 1, 13 stations were taken along a length of 300 miles. Mr. M. C. Lester, chief officer of the *Scoresby*, made some useful observations on ice conditions. The plankton was found to be characterised by a number of forms which are not found on the South Georgia grounds, among them *Euphausia crystallorophias*. This species was found in considerable abundance and may prove to be the chief food of whales frequenting the ice edge.

Returning to South Georgia the *Scoresby* was docked, and with minor repairs and boiler cleaning was not ready for sea until the end of November. She then made a passage to Port Stanley, again taking a line of stations, and on returning to South Georgia she began an extended survey of the whaling grounds. This survey, which is illustrated in Fig. 2, is the most thorough which has yet been made. The lines of stations extend seawards far beyond those previously taken. Of the total number of 53 stations, 44 include full hydrological observations in addition to the plankton work. In spite of very severe weather during the first half of the period, the entire survey was completed in one month (Dec. 16–Jan. 15), during which the two members of the scientific staff (Messrs. D. D. John and J. W. S. Marr) worked almost unceasingly. Great credit is due to them and also to Capt. R. L. V. Shannon and his crew, for a very remarkable performance. At the conclusion of the survey a series of continuous oblique nets was hauled over a distance of 30 miles.

The cruise to the South Shetlands, which (as already explained) was frustrated by pack-ice in the previous season, began on Feb. 5, and the entire programme as shown in Fig. 3 was put through without the necessity of returning to South Georgia for fuel. Between South Georgia and the South Shetlands eight stations were taken, and in the Bransfield Strait, where peculiar hydrological conditions exist, three lines of stations were made. The return passage to the Falkland Islands was made via Drake Strait and Cape Horn. Here the weather lived up to its evil reputation, and the seven stations on this line were accomplished with some difficulty in heavy swells. Three further stations were taken between the Straits of Lemaire and the Falkland Islands, and seven plankton stations on the return to South Georgia. The season's work concluded with two lines of stations on the south-west side of the island.

In this brief synopsis of the work done by the *William Scoresby* during some sixteen months, it has not been possible to make any statement regarding the results obtained. The small scientific staff, for most of the time only two in number, was very fully occupied in the collection of data and material and was without time even for a

CAPE NORTH
HOFFLAND BAY
SOUTH GEORGIA
FULL STATIONS - ● NET STATIONS - ○
CONTINUOUS OBLIQUE HAULS WITH ONE METRE NETS - ●
1000 METRE CONTOUR LINE (APPX) -

FIG. 2.—Chart illustrating the work carried out by the R.S.S. *William Scoresby* off South Georgia during December 1928 and January 1929.

preliminary inspection of what had been obtained. There are indications that results of great interest will follow, but at the moment all that can be said is that, thanks to the enthusiasm shown by the personnel, the work of maintaining continuity of observations during the past two seasons has been most successfully performed. On three different occasions surveys of the South Georgia whaling grounds have been carried out; connected lines of stations have been taken covering a wide area, and special observations have been made in Bransfield Strait. The trawling survey in the Falkland area has been continued and valuable work done on the edge of the pack-ice.

Whale-marking.

The *William Scoresby* has been so fully occupied with observations on plankton and hydrology that, as was foreseen, she was not able to make any serious experiments in whale-marking. During the past season, however, the Discovery Committee was able to arrange with one of the whaling companies at South Georgia for the occasional use for this purpose of their spare whale catcher. Three cruises, each accompanied by one of the scientific staff, have been made in this vessel. On the first occasion a visit was paid to the ice edge east and south of South Georgia, where many whales had been sighted by the *Scoresby*, but owing to the very bad weather which was encountered only two whales were marked. The remaining two cruises, each completed in three days, were made on the South Georgia grounds and proved far more successful.

On the first occasion 72 certain hits and 13 doubtful were recorded, while on the second the figures are 25 certain and 2 doubtful. It is thought that at least 13 whales on the first occasion and 3 on the second were marked twice. The whale-marking operations were in charge of Mr. J. W. S. Marr and Mr. G. Rayner, Capt. Evensen, who was in command of the vessel, doing his utmost to ensure success.

Since the investigations began, more than a hundred whales have now been marked, most of them during the present year. So far, no marks have been returned and the possibility that some may have been overlooked during the process of flensing is disquieting. Recent experiments have resulted in the production of an improved mark, having an aluminium shaft which will not warp under sea-going conditions, a stream-line covering to the head, giving flatter trajectory and increased range, and with a tag of brightly coloured material attached to facilitate recognition.

Whaling Factories.

During the past two seasons opportunities have arisen for undertaking some scientific work on whaling vessels. In 1928, Mr. J. E. Hamilton accompanied the whaling factory *Anglo-Norse* on an expedition to the South Sandwich Islands, and in the following season Dr. E. H. Marshall visited the Ross Sea in the *C.A. Larsen*. On each of these voyages data were obtained on all whales captured, and as a result of facilities kindly given by the managers, serial observations on the hydrology and plankton were also made. The work accomplished will be of value in comparison with the more detailed investigations carried out on the research ships and at the biological station.

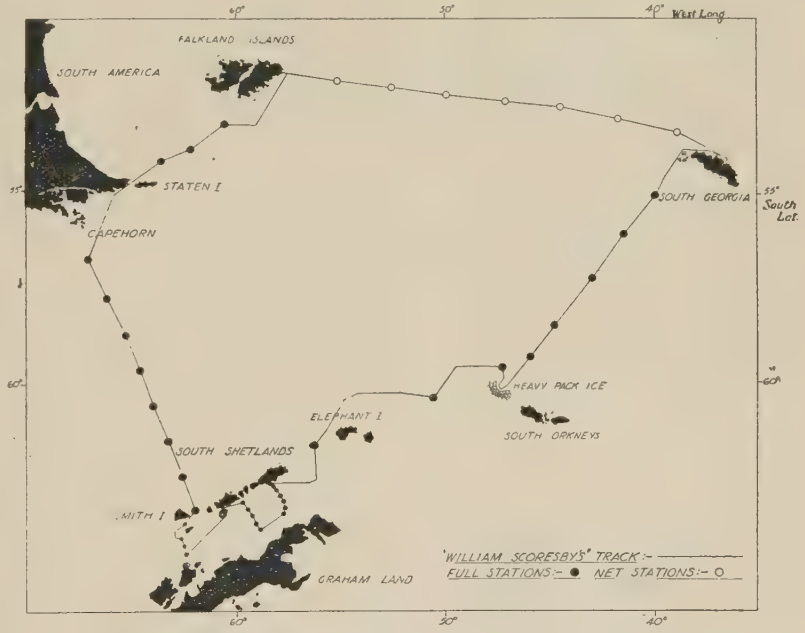

FIG. 3.—Chart illustrating series of observations between the Falkland Islands and their Dependencies made by the R.S.S. *William Scoresby* during February 1929.

The Marine Biological Station, South Georgia.

The Marine Biological Station was reopened at the beginning of February 1928, with Mr. F. C. Fraser in charge, and from then until it was closed at the end of April 1929, 836 whales have been examined at the neighbouring whaling station. The staff also examined 29 whales at Deception Island, which was touched on the voyage to South Georgia, making a total of 2549 whales examined since the observations were commenced in 1925.

Most of the routine work of previous seasons has been continued. This includes observations on colour, external and internal parasites, stomach contents, condition of blubber, of external and internal genitalia and of mammary glands. All mature females have been examined for fœtuses.

In previous seasons full series of measurements have been taken of every whale examined, but sufficient data of this kind had already been obtained for blue and fin whales, and in consequence full measurements were only taken of other species.

Altogether, whales of five different species have been examined. Blue and fin whales have been predominant, sei whales have occurred towards the end of both seasons, sperms have been taken more infrequently, and three humpbacks were examined during the few days allowed for their capture in December 1928.

Considerable variability was found to exist in the different species in the proportions of males to females. In blue and fin whales, males and females occurred in approximately equal numbers, by far the greater number of sei whales examined were female, and all the sperm whales were male. The stomachs of all whales were examined for food content, only 'krill' (Euphausians) being found in the whalebone whales. Special attention has been paid to the diagnosis of maturity, as indicated by an examination of the genitalia, and a considerable amount of data concerning fœtuses has been collected. In all, 124 records of pregnancies have been obtained. Many of the smaller fœtuses have been preserved, the smallest found measuring only 18 mm. in length. Towards the end of the 1927–28 season, a blue female was found to contain a fœtus measuring 7·46 m. (more than 24 ft.) in length, the parent giving every indication of approaching parturition. As in previous seasons, the average size of the fœtuses was found to increase as the season progressed, although the variation in size was considerable at any one period. Two instances of twins have been observed, and this season at one of the whaling stations at South Georgia, a whale having six fœtuses was caught. Roughly, one-third of the immature fin females were found to possess the structure known as the vaginal band. It was also found in one immature sei female, and a doubtful instance of its presence occurred among the blue whales.

The mammary glands of all female whales have been examined and the presence of milk recorded. The stomachs of young whales have been examined for evidence of milk feeding. Although it is exceptional, two fin whales and one sei whale were found to be pregnant and lactating at the same time.

Observations on the colonies of elephant seal which inhabit South Georgia were made from time to time by Mr. G. Rayner, and Mr. G. E. R. Deacon, hydrologist, was fully occupied in the analysis of water samples obtained by the *William Scoresby*.

Coastal Survey.

During the previous commission the survey officer, whose services had been lent to the Committee by the Admiralty, was chief officer of the R.R.S. *Discovery*. Facilities for survey were given whenever possible, and a considerable amount of useful work was done, but the Committee felt that it would be an advantage in future operations to detach a survey party as a separate unit, thus allowing the officer-in-charge to devote his whole time to this work. In accordance with this plan, Lieut.-Comdr. J. M. Chaplin left England by a whaling transport vessel in September 1928. He took with him an assistant, a motor mechanic, and three men, together with a specially designed motor launch. The party arrived in South Georgia in October, and work began at the end of the month.

The season was a bad one for survey operations; much fog prevailed, and sights could only be obtained on rare occasions. In Stromness Bay, Husvik, Leith, and Stromness harbours were surveyed in detail, with some soundings in the approaches, and surveys were also carried out at Maiviken and Jason Harbour in East Cumberland Bay and at Godthull farther to the south-east. In February 1929 the survey officer accompanied the *William Scoresby* on her passage to the South Shetlands, Cape Horn, and the Falkland Islands, during which observations were made at Elephant Island and near Smith and Low Islands and a round of angles taken from the highest point of Deception Island. Observations for magnetic variation were made in the Falkland Islands.

While this work has been in progress in the south, those of the scientific staff who have remained in England have been occupied with the preparation of results. It is expected that the first volume of the Discovery Reports will be completed during the present year. A station list covering the period of the first commission has already been published and also a paper by S. Kemp, A. C. Hardy, and N. A. Mackintosh on the objects of the investigations and the equipment and methods which are employed. A lengthy whaling report by N. A. Mackintosh and J. F. G. Wheeler is in the press, together with papers on elephant seal and on the birds of South Georgia by L. H. Matthews, and on parasitic Nematoda and Acanthocephala by H. A. Baylis. Work on certain of the hydrological and plankton results is well advanced. The Admiralty has recently published charts embodying surveys carried out by Lieut.-Comdr. J. M. Chaplin, and these charts will also be issued with the Discovery Reports.

The *Discovery* has been chartered to the Commonwealth Government for an Antarctic expedition under Sir Douglas Mawson, with Captain J. K. Davis in command of the vessel. Mr. J. W. S. Marr, of the Discovery Committee's scientific staff, has been seconded to accompany the Australian expedition, on which he will take charge of the plankton investigations. For the continuance of the Committee's work in the Dependencies of the Falkland Islands, a new vessel, to be named the *Discovery II.*, is now under construction at Port Glasgow, and it is expected that she will be ready to sail for the south before the end of the present year.

National Surveys.[1]

By Brigadier E. M. JACK, C.B., C.M.G., D.S.O.

EVERY civilised country—I think without exception—has a national survey; that is, a survey department, or in some cases more than one department, controlled by the government. But when we come to inquire into their activities, we find considerable differences in organisation and methods and in the actual duties allotted to these departments, and it becomes a matter of interest to inquire what are, or should be, the characteristics and functions of a national survey.

One function should be the production of a map. Here we are faced with the fact that every country must decide for itself what maps it requires. Because Great Britain publishes maps on seven different scales it does not follow that South Africa need do the same. The maps required by a country depend on local conditions and circumstances. It is clearly impossible to lay down any hard and fast rules, but we may perhaps arrive at some general principles.

I have spoken of there being an infinite variety of maps, but they may be divided into different kinds and classes, and for our purpose it will be convenient to consider maps under two main headings, namely, cadastral and topographical. My own view is that it is the proper function of a national survey to make adequate provision for maps of these two kinds, cadastral and topographical, because I consider them of such great importance to any community and any country.

The functions of a national survey, and the duties for which I think it should be responsible, are as follow:

1. The national survey should be the sole survey authority in the country.

2. It should be under one control in all its operations, from the triangulation to the publication and sale of the map, and its revision.

3. It should be responsible for an accurate network of levels throughout the country.

4. It should produce, or control the production of, all cadastral maps.

5. It should produce, or control the production of, a good topographical map of the whole country.

6. Maps used for land registry or similar government purposes should be the national survey maps, or directly based on them.

7. All maps produced by or under the control of the national survey should be reproduced and should be readily available to the public.

8. Adequate provision should be made for the revision of all maps.

Let us now consider some of the national surveys of the world, and see to what extent they comply with, or differ from, the standard which I have laid down.

Taking the surveys of Europe first, we find a strong likeness among them. They all, or nearly all, have certain characteristics in common. These are, first, that a military department is responsible for all topographical mapping in the country; second, that such cadastral maps as exist are produced by an independent department; third, that it is very rare to find cadastral maps published. The view taken generally in Europe is that good topographical maps are a prime necessity for military purposes, hence the military character of their topographical surveys; that cadastral maps have no military value, and are chiefly required for revenue purposes; and that such cadastral maps are documents mainly for government use, or for occasional reference by the public, so that reproduction and publication are unnecessary. As a result of these views we find that, generally speaking, European countries have good topographical maps.

The Survey of Egypt has a wide reputation for excellence and efficiency, and it is fair to note that its organisation and development are due almost entirely to British control and supervision. In Egypt we find one survey department, responsible for all survey operations, including levelling.

It may fairly be said that Canada is showing a fine example in carrying out systematic surveys of her territories, surveys geodetic, topographical, and cadastral. At the same time I do not think that the organisation of surveys in Canada or in the United States is one to be copied. It is fairly obvious that there has been in the past a great deal of independent and un-co-ordinated effort in both countries and that the present situation, while no doubt working well practically, is a compromise; and the suggestive and advisory functions of a board can never, in my opinion, take the place of the personal control of a director.

The Survey of India has deservedly a world-wide reputation. It is a highly organised and admirable survey, which in its geodetic and other scientific work can bear comparison with any other in the world. On the mapping side its activities are, however, confined solely to topographical work. The Survey of India produces maps on the scales of 1-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch to the mile, as well as various smaller scales. Revision of these topographical maps is contemplated, but exists more in theory than in practice. The Survey prints and publishes its own maps.

Cadastral work in India is done on a provincial basis. A native official called the *patwari* of each village is responsible for keeping up-to-date a map of his village, with its property boundaries. In some provinces the technical part of these surveys is done under an officer lent by the Survey of India.

Ceylon has a first-rate survey, which is responsible for all operations; and the same applies to the Federated Malay States Survey. Similarly, most of the African Colonies and Protectorates have a single survey authority, responsible for all survey work in the country. Examples are the Gold Coast, Nigeria, and Uganda, in which, although the survey is in an early stage and much territory remains to be done, the organisation and the

[1] From the presidential address to Section E (Geography) of the British Association, delivered at Cape Town on July 23.

programme of work are complete and comprehensive, and often include schools of training for natives, and full equipment for reproducing and printing their own maps. On the other hand, we get Nyasaland, with a 'Lands Officer' and a negligible staff; and Northern Rhodesia, where a very small staff is wholly occupied with cadastral work, and has neither the means nor the opportunity to undertake much-needed trigonometrical and topographical work.

In both Australia and New Zealand a great deal of cadastral work is done, in the form of surveys of property and lands, frequently isolated; but in neither country is there, so far as my information goes, any system of cadastral survey organised on the lines we have been considering.

New Zealand has a few topographical maps, mainly of manœuvre areas, produced under the military department. In Australia topographical maps are, according to my information, almost completely lacking. New South Wales has a triangulation of the highest class, and a certain amount exists in other States. Proposals have been made for carrying out a geodetic survey of the whole of the States under Federal arrangements; but these proposals contemplated only the establishment of first and second order triangulation, and so far as I am aware did not even entertain the idea of carrying the work through to the stage of mapping.

In any statement of the form that an ideal national survey should take, I would lay great stress on the desirability of unity of control of all forms of survey. There should be only one survey authority in a country, and there should be a single control of all survey operations from start to finish. Perhaps the chief point that strikes one in analysing the organisation of national surveys is the lack of such unity. If we except the Ordnance Survey and the Survey of Egypt, and certain British colonial surveys, such unity of control is conspicuous by its absence; and one of the most characteristic features of foreign surveys is the almost complete divorce of cadastral from topographical work. They seem to be commonly regarded as things apart.

The idea of a single department responsible for all forms of survey appears to be a British idea, as it is only in countries of British nationality or controlled by British that it is found. In fact it might almost seem that in stating what I believe to be the sound and ideal form of organisation for a national survey I was merely quoting the practice of the Ordnance Survey. But that is not so. I do not argue that the organisation that I advocate is right merely because it is that of the Ordnance Survey, but because it seems to me absolutely sound and defensible arguing from first principles. The British people have an extraordinary faculty for getting practical things done, and in the end often done well; but logical and orderly thinking out and arrangement is the last quality I would claim for them as a race. Yet it does seem to me that in survey matters the British have developed eminently logical and sound ideas and have put them most beneficially into practice.

All surveyors will agree that the idea that there is any essential difference between a cadastral and a topographical map is absurd; the difference is merely one of degree and not of kind. It seems, therefore, logical to argue that both should be produced and maintained by the surveyor. Indeed, one may put it more strongly, for it is obviously wasteful to send one party into the field to produce one kind of map, and another to produce another kind, when one good map would serve as a basis for all kinds. In Europe the so-called cadastral maps are regarded much less as maps than as diagrams and documents necessary for the purpose of supervising revenue. They have become to a large extent the documents of a financial department. The question obviously arises whether the countries in question have suffered from this policy. If the argument that all survey should be under one direction is sound, one should be able to show that some disadvantage has resulted where this rule has not been followed. Can this be shown? Let us take France as a typical example.

France has a cadastral survey, on a large scale—usually 1 : 2500—made on the average about a hundred years ago. So far as one can judge—and we had opportunities for doing so during the War—this survey, though not based on any triangulation, was a reasonably accurate one. It has been left practically untouched since. The manuscript plans that one may see on application in the *mairie* of any commune show the country as it was in the time of Napoleon.

This survey must have cost a lot of money to carry out, and the map when produced must have been of great value to the country. Owing to lack of revision, the value of that map to the country has steadily deteriorated until now, when it must be widely negligible. I cannot believe that if this map had been in charge of a surveyor it would have been allowed to deteriorate in this way. I cannot believe that he would not have maintained it and made as accurate a map as possible. It appears to me, therefore, that France has definitely suffered from allowing this once valuable map to remain in charge of a purely fiscal department.

Take the question of publication. To survey and map any country is an expensive business; and it is particularly expensive to carry out a cadastral survey, presuming that it is a reasonably accurate survey, on account of its large scale and the great amount of detail that has to be mapped. Now the cost of reproducing and printing such maps is almost infinitesimal compared with the cost of surveying them; and it seems to me a 'penny wise and pound foolish' policy to refrain from the small extra expense that would be entailed by publication. The maps embody a large amount of information of value to the public, and obtained at public expense. It seems only reasonable, therefore, that this information should be made available to the public.

Human activities take very similar forms all the world over, though there may be superficial differences. Since the world began men have bought and sold houses, estates, lands; and a usual accompaniment of such sales is a map or plan. In

ngland, where accurate 25-inch plans exist for all ltivated and inhabited country, it is easy to otain such a plan. In France, where the once od plans no longer have any value, they must be ade afresh. Here again I think we may say that rance has suffered through not carrying through r survey policy to its logical conclusion.

Another point that may be mentioned is the uestion of military value. European countries sumed prior to the War that cadastral maps were no military value. As the War went on, the emand grew for maps of larger and larger scale. ngland was no wiser in this respect; but she was uch wiser in her survey policy. Had the war curred in England, it would have been an easy atter to supply maps of any scale required. In rance how often must the armies have wished that od, accurate large-scale maps were available! s it was, we had to make those maps ourselves. e used the hundred-year-old French cadastrals, id were very glad to have them; but how normously their value would have been enhanced id they been modern, up-to-date maps!

The conclusion seems justified that France has ffered definite disadvantages owing to her policy letting her cadastral maps become mere docuents of a financial department, and of not carryg out her survey to its complete and logical end; id the same conclusion will apply to other ountries in a similar situation.

In the United States and in Canada division of sponsibility of another kind used to exist. The sadvantages of such a state of things and the need r unity of control was felt, and has been met y the establishment of Survey Boards. I believe at the existing system works well and without iction, but I believe also that this is due mainly to ne common sense and goodwill of the men working , rather than to any advantages in the system.

What is the survey situation in South Africa at resent? In January 1921 a Survey Commission as appointed, and in July of the same year it sued a report. This was not by any means the rst report on survey questions in this country that ad been made; nor was this Commission the only ne that has investigated the subject; but as it is ne latest, and the only one on the recommendaons of which action has been taken, we may conne our attention to it. The report of this Comission is a most admirable document; and if I uote from it, my excuse must be that Government ocuments are seldom read except by the few who re professionally and immediately interested.

The Commission directed attention to the great aste that resulted to the country in the absence of scientific system of carrying out cadastral surveys; it pointed out the need for greater cordination and unity of control in survey matters; nd it dwelt very strongly and forcibly on the great eed for a good topographical map of the country. he Commission made a large number of recomendations, all in the direction of securing greater nity and more reliability and scientific precision the surveys of the country, and of making the rvey more complete and comprehensive. As a consequence of this report, in 1927 a Survey Act was passed, which gave effect to most of the recommendations of the Commission, though not to all.

The situation with regard to cadastral surveys in South Africa is difficult. A vast amount of surveys of farms and properties has been done, and exists stored in various archives. It varies largely in quality, but includes much most valuable material. But it is most difficult of access, and it has long been felt by the thinking surveyors of South Africa that more use should be made of it. The subject has been ably dealt with in an article in the *Survey Journal* for March 1924 by Mr. Whittingdale, who argues that it should be collected, co-ordinated, and plotted in the form of a regular series of cadastral plans. Whether such a work would be practicable I am not competent to say, though it is interesting to note in the same article that experimental cadastral plans, presumably made in the suggested way, have already been constructed in the office of the Surveyor-General, Cape Town. But of its desirability I have no doubt whatever. It is, to my mind, a cardinal principle that survey work that is done should be published and made available; otherwise it is largely wasted; and the preparation of a series of uniform cadastral plans of the dominion should, I think, take a high place in the Survey programme. It should not be forgotten, of course, that certain compilations of the existing farm surveys have been made in the Transvaal, Orange Free State, and Natal, but these do not quite meet the want.

The Survey Commission did not touch on the question of a regular cadastral map, but it devoted a substantial part of its report to the subject of topographical survey. South Africa is at present singularly deficient in good topographical maps, and there is, I think, little doubt that they are a crying need. The need for such a survey has been consistently advocated for many years past; and it is difficult to add anything of value to the arguments which have already so often been put forward. My excuse for speaking at all on the subject is that public apathy in the matter is so great that it is only by constant reiteration that one may entertain a faint hope that at some time a little interest may be aroused.

The Survey Commission stated that in South Africa a topographical survey is particularly necessary from the geographical circumstances of the country. It pointed out that, in the absence of waterways, roads and railways must be laid down before a country can begin to progress; and further, that irrigation and conservation of water will play a great part in the development of the land. It then stated that a necessary preliminary to undertaking any schemes of the nature mentioned was a knowledge of the topography, and that a good topographical map would save enormous sums that are continually being spent in reconnaissance, and would obviate a great amount of wasted effort. To this weighty statement we might add the enormous value of a good topographical map to all who are concerned in the government and administration of the country.

Another reason which makes the need of a topographical map of first importance is the question of geological survey. Geological information is deprived of a great part of its value until it is correctly plotted on a reliable map. Perhaps the best example and proof of this is the case of the Geological Survey of the United States. In that rapidly developing country it was felt that geological survey must be pushed on as fast as possible. The geologists found, however, that they must have good topographical maps ; and there being none in existence, they set out to make them ; with the result that the Geological Survey of the United States includes the topographical survey. In South Africa the same considerations apply with peculiar force ; and it seems incredible in a country where geological survey and mineral development have such possibilities, that the value of a topographical map should have been so long ignored.

The present situation with regard to topography in South Africa is as follows : There is a good topographical survey (1 : 125,000 scale) of the Orange Free State, with an extension for a short way into the Transvaal. There is a 1 : 250,000 survey of Basutoland and of the northern part of the Cape Province. The latter is classed as a ' reconnaissance ' survey ; it is useful, but in Cape Colony at any rate scarcely adequate to the needs of the dominion. Of the remainder—about half of the Cape Province, almost the whole of Natal and the great bulk of the Transvaal—no topographical map exists. It will be seen that a vast amount remains to be done in the way of topography.

It is true that a start has been made with topographical survey of the country. The Director of the Trigonometrical Survey has been charged with this duty, and a sum of money has been allotted for it. The sum seems to an outsider, considering the immense amount of work which has to be done, to be extraordinarily small. It is something that the principle has been recognised, but no adequate progress will be made until a much larger sum is allotted. The question is also bound up to a large extent with that of staff. So far as I am aware, the Director of Trigonometrical Survey has no permanent staff for field work, and very little for work in the office. This is to be regretted. In my view a government survey ought to have a regular permanent staff ; otherwise it is liable to have fluctuations in the quality and quantity of its work which are most undesirable. It may of course be convenient, and usually is in the early stages of a survey, to have in addition a certain number on a temporary basis. The same observations apply to the staffs of the surveyors-general. In all cases there should in my opinion be a staff of permanent government employees. All experience goes to support this view. The example of Canada may be quoted. Cadastral surveys there used to be put out to contract, but this was dropped in 1915, and I am informed that all the men engaged on survey work are now civil servants. It is to be noted that the Survey Commission laid particular stress on this point, especially in the case of the trigonometrical and topographical surveys.

The most satisfactory feature in South African survey is perhaps the triangulation ; it is all of good quality, and is being pushed on as fast as funds will allow ; but there is undoubtedly a great need of extension in the second and particularly in the third order triangulation. Some levelling has been done, but nothing as yet in the way of closed circuits ; so that levels are at present, to use a common expression, hanging in the air. All surveyors know that it is impossible to check the accuracy of any levelling, and to distribute the errors, until the work has been closed on the starting point.

South Africa has a great survey tradition behind it. Some of the greatest survey schemes were started in this country ; some of the finest survey work in the world has been done in it ; and some of the best surveyors of the Empire have been trained here. South Africa ought not to be content to lag behind other nations in this matter.

Obituary.

PROF. S. B. SCHRYVER, F.R.S.

BY the death of Prof. S. B. Schryver, which occurred on Aug. 21, an active worker in biochemistry—still in the prime of his intellectual powers—has passed away.

Samuel Barnett Schryver was born in London in 1869, the son of the late Lewis Schryver. He was educated at University College, London, and at Leipzig, his first appointment being that of assistant lecturer and demonstrator of chemistry at Liverpool. Afterwards he returned to London as lecturer on physiological chemistry at University College and chemist to the Research Institute of the Cancer Hospital. In 1913 he was chosen as assistant professor at the Imperial College of Science and Technology, and in 1920 he was appointed professor of biochemistry at the College. He was elected a fellow of the Royal Society last year.

About a hundred papers and notes stand to Schryver's credit. In 1890, in collaboration with Prof. J. Norman Collie, he showed that when a mixed quarternary ammonium chloride or hydroxide is heated, a mixed tertiary amine is produced, and in the following year he proved the existence of stereoisomeric quarternary ammonium compounds, thus confirming the view of Hantzsch and Werner. His work on the oxidation products of turpentine oil threw much light on the constitution of camphoric acid. Based on the fact that ammonia is liberated when sodamide and phenols interact, he devised a method of estimating these compounds. He worked on morphine, and studied the effect of feeding animals with thyroid.

Schryver's most important work was undoubtedly that connected with the proteins. He published a monograph on " The General Characters of the

Proteins" (Longmans' series) in 1909. In 1905 and 1906 the independent work of Schryver and Leathes proved that proteins are assimilated as amino-acids, the greater part of which is converted into urea by the liver cells and excreted by the urine. He was successful in applying Siegfried's carbamate method for the separation of the products of hydrolysis of the proteins, and by its means he was able to isolate several hitherto unknown substances. Among these may be mentioned oxylysine, $C_6H_{14}O_3N_2$, from isinglass, albumin of cabbage leaves, and edestin. Protoctine, $C_8H_{15}O_3N_3$, was obtained from oat protein.

Connected with his work on proteins, a series of ten papers on gelatin by Schryver and his pupils appeared between the years 1921 and 1927. The main object of this inquiry was to obtain a product of better technological value than commercial gelatin, and most of the work is therefore embodied in Reports to the Adhesives Research Committee of the Department of Scientific and Industrial Research. This work brought him into connexion with numerous firms manufacturing adhesives, to which he acted as consultant. Regarded as a whole, the work stands out not only from its industrial merit, but also as a notable contribution to pure chemistry, in which refined methods of physical chemistry were brought into use.

Gelatin was found to possess nearly all the properties of a globulin, but even when purified by treatment with 0·2 per cent caustic soda and by repeated flocculation in an electric field, it is shown not to be a chemical entity. When the purified substance is heated with water, treated with acids or alkalis, or repeatedly flocculated in an electric field, the hydrolytic products show an increase in the nitrogen that will not react with nitrous acid. Do not these observations of Schryver indicate the necessity of tempering our conclusions—drawn from the chemical substances we isolate from a given neutral product—with caution? The proteins, the polysaccharides, etc., exist in Nature in a form combined or co-ordinated with other substances.

In 1923 a communication was made from Schryver's laboratory showing that a crystalline carbohydrate can be separated from cabbage leaves in a yield of 0·01 per cent. It is non-reducing and its constitution is probably

$$CH_2OH \cdot CH(OH) - O - CH_2OH.$$

Several important papers emanated from Schryver's laboratory on the chemistry of pectins and their relation to the so-called hemicelluloses and other cell-wall constituents of plants. His work corroborated the ring formula assigned to pectic acid by work in my own laboratory. In 1910, Schryver found that formaldehyde is formed during the insolation of green leaves, but that it exists in combination with chlorophyll. In the course of this he improved Rimini's test for formaldehyde so that it became sensitive to a concentration of 1 in 1,000,000. Among researches in physical chemistry Schryver worked on the state of aggregation of matter and on clot formation, the latter explaining the formation of casein from caseinogen by rennet and the effect of salts.

Prof. Schryver was a man of great personal charm who endeared himself to all his colleagues and pupils. His work was essentially original, based strictly on experimental results without the slightest bias of convention.

ARTHUR R. LING.

WE regret to announce the following deaths:

Dr. J. R. Eckman, associate chemist in the U.S. Bureau of Standards and lecturer in physical chemistry at George Washington University, on Aug. 1, aged forty-one years.

Dr. H. C. Frankenfield, who was in charge of the river and flood service of the U.S. Weather Bureau, on July 31, aged sixty-six years.

Prof. W. H. Perkin, F.R.S., Waynflete professor of chemistry in the University of Oxford, on Sept. 17, aged sixty-nine years.

Dr. J. M. Purser, Regius professor of physic in the University of Dublin from 1917 until 1925, and author of a "Manual of Histology" and of numerous papers on physiology, pathology, and medicine, on Sept. 18, aged eighty-nine years.

News and Views.

IN commenting as we did in these columns in our last issue on Dr. Bonhoeffer's recent work on hydrogen, we should have directed attention to the fact that in NATURE of Feb. 2 this year (p. 160) we published an account of experiments made by Prof. J. C. McLennan and his co-worker, Mr. J. H. McLeod, that established the existence in liquid hydrogen of two distinct kinds of molecules. In these experiments it was shown that when liquid hydrogen was irradiated with the light from a mercury arc, Raman effects were obtained that indicated that both sets of molecules were set into oscillation with the same *vibration* frequency, namely, 4159 cm.$^{-1}$. One of the sets of molecules was, however, set *rotating* with a frequency of 354 cm.$^{-1}$, corresponding to a transition from a zero to a two-quantum rotational state, while the other was set *rotating* with a frequency of 588 cm.$^{-1}$, corresponding to a transition from a single-quantum rotational state to a three-quantum one.

THESE experiments showed that in liquid hydrogen we had some molecules in a zero-vibrational and zero-rotational state and others in a zero-vibrational and first quantum rational state. Intensity measurements showed that there were considerably more (at least twice as many) molecules in the second state than in the first one. The distinctness of the two states was emphasised by the fact that no Raman effects were obtained corresponding to $m=0$ to $m=1$ or $m=1$ to $m=2$ rotational transitions. Dennison, it is well known, in attempting to explain anomalies in the specific heat of hydrogen, had shown by the use of wave mechanics that hydrogen at low temperatures should be regarded as a mixture of two effectively distinct

sets of molecules defined as symmetrical and antisymmetrical. It will be seen, therefore, that the experiments of Prof. McLennan and his colleague constitute a brilliant experimental confirmation of that view.

ON Sept. 30 occurs the centenary of the birth of Franz Reuleaux, who has been called the father of kinematics. Born at Eschweiler, near Aachen, he acquired his early engineering experience under his father, and then for four years he was a student at Karlsruhe, Bonn, and Berlin. In 1858, at the age of twenty-nine years, he became professor of mechanics and technics at the Zurich Polytechnic School, from which in 1868 he passed to the Berlin Technical Institute and then to the Technical High School at Charlottenburg. His first contribution to engineering literature was a paper written when he was a student on "The Resistance of Materials", in which he directed attention to the molecular stresses of metals and to the necessity of taking into account the limit of elasticity together with the breaking strain. The book by which Reuleaux is best remembered is that entitled "Theoretischen Kinematik", published in 1875; in the following year an English translation of this was published by the late Sir A. B. W. Kennedy, under the title "The Kinematics of Machinery". An indefatigable worker, a member of many associations, Reuleaux served on the juries of several international exhibitions, and his outspoken views on the quality of the German exhibits at the Philadelphia Exhibition of 1876 caused much heartburning in German industrial circles. With his countrymen Redtenbacher, Zeuner, and Karmarsch and others, Reuleaux did notable service in stimulating engineering enterprise and research, and in raising the standard of machine design.

ONE of the most difficult problems in connexion with television is to get the receiving and transmitting apparatus to move absolutely in step with one another. If the same alternating current network of supply is available, this can be done quite satisfactorily by two synchronous motors, without the necessity of providing a separate channel for synchronising purposes. It would be possible to use oscillating quartz crystals or tuning-forks, but the connexions are so complicated and the expense so great that they would be impracticable in television. This difficulty has been surmounted by J. L. Baird by utilising the current which illuminates the neon tubes producing the picture. The perforated disc is driven by a small motor on the shaft of which is mounted an iron disc with narrow teeth projecting from its circumference. The neon tube currents pass through two electromagnets. When the synchronism is perfect the teeth pass the magnets during the extremely brief dark intervals between one picture element and the next. During these intervals there is no current in the magnet coils, and thus they have no effect on the iron disc. We have seen the device working well when simultaneous speech and television was being demonstrated between two rooms of Baird's laboratory at 133 Long Acre, W.C.2. Television receivers of this pattern are being put on the market in Germany by the Fernseh A.-G., which is the Baird organisation in that country. We understand that similar apparatus will be available in Great Britain when the television broadcast service is in regular operation.

AT the conference of the Association of Special Libraries and Information Bureaux, held at Cambridge on Sept. 20–23, Mr. E. W. Ashcroft read a timely paper on our technical English vocabulary. Words describing half-understood engineering and scientific processes occur often in technical journals, but they cannot yet be said to form a part of our language. The time for standardising words of this kind has not yet arrived. In the engineering industry the standardising authority is the British Engineering Standards Association—the BESA. It has recently published a glossary of technical terms with the object of standardising the electrotechnical terms used in the British Empire. This provides the basis also of the British portion of an international vocabulary which is being prepared by the International Electrotechnical Commission. Several difficulties have arisen which are still the subject of discussion. For example, it was thought desirable to standardise so far as possible the ending 'or' when designating a piece of apparatus or a machine for accomplishing a definite purpose. The ending 'er' was to be applied to the person who carries out the operation. On investigation, however, it was found that this seemed only feasible with words of comparatively recent origin. Thus the spelling of condenser, controller, transformer, voltmeter, and many others still stand, but the names 'arrestor', 'convertor', 'selector', and 'startor', and others were adopted as the names of pieces of apparatus recently invented. Difficulties arose in connexion with trade names like 'megger' and 'ohmer'. The question is a thorny one. We do not agree that it matters little what usage is adopted so long as it is general. This, perhaps, is true of commerce, but it is for the common good to have a logical as well as a definite nomenclature.

THE new London broadcasting station at Brookman's Park, from which experimental transmissions are now being sent, is very conspicuous from the Great North Road between Potter's Bar and Barnet. It has four insulated masts; the more northerly pair support the aerial from which the broadcasts are being made, and the station is at present working on the normal 2LO wave-length. The power station is a large building covering three-quarters of an acre and is centrally situated with regard to the four masts. It contains four Diesel engines, each generating 300 horse-power. In the centre of the dynamo room are three machines, each capable of generating 160 kilowatts at any pressure between 7000 and 12,000 volts direct current. When the station is completed the other aerial will send simultaneously another programme on a different wave-length. Two machines will be working and one will be kept in reserve. Two small storage batteries are kept for heating the filaments of the valves, as it is essential to have no ripples in the current. Very special precautions are taken to maintain the

wave-length constant. At present the programmes are received by underground lines running from the studios at Savoy Hill on the Embankment. There are two sound-proof listening rooms at Brookman's Park, one for each transmitter, where the quality of the speech and music is checked by a loud speaker. In order to avoid the risk of accidents with aeroplanes in this district, and for other reasons, the Government limited the height of the masts to 200 ft. A red electric lamp at the top of each mast warns aircraft to avoid attempting to land in the neighbourhood. From the engineering point of view, much taller masts would have been more desirable.

THE London County Council, in connexion with the proposed large power station at Battersea, recently communicated with the Berlin Electricity Company asking for information about the Klingenberg Power Station. This is a very large power station (270,000 kilowatt), situated in a rather thinly populated district in the south-eastern suburbs of Berlin. In particular, the L.C.C. wanted to know whether nuisance was caused by ash, smoke, or sulphur fumes, and whether difficulties arising from these causes could be readily overcome. In its reply, the Berlin Company states that it has had practically no complaints in regard to sulphurous fumes, and that no harmful effects on health or vegetation had been observed. The latter effect, however, is difficult to detect until after long observation. The coal used has a small sulphur content, and possibly the coal used in Great Britain has a larger one. The German engineers believe the best solution of the problem lies in the use of higher chimneys. The chimneys at Klingenberg are 225 feet high, but in the new German power station near Siemenstadt the chimneys are nearly 400 feet high. The German company states that it has received many complaints about the floating ash and grit discharged from the chimneys. This comes down sometimes almost like a shower and causes much annoyance. The station burns pulverised fuel, which has a large ash content. Ash catchers of various kinds are now used which trap some eighty per cent of the floating ash. Experiments are being made with a water-washing process, in which the gases are forced through several ' veils ' of water. A somewhat similar method is also being used to trap the sulphur fumes.

MARCONI'S Wireless Telegraph Co., Ltd., has obtained an order for a large extension of the Polish broadcasting organisation, which, following the English example, is to be remodelled so as to provide alternative programmes for the greater part of the country. The new equipment will comprise one 120 kw. aerial input broadcasting transmitter with full modulation, two high-power regional stations with 16 kw. aerial input, and three local relay stations. Provision will be made for simultaneous broadcast facilities throughout the whole of Poland, the relay stations transmitting on a common wave-length employing the tuning-fork system of control, such as has been in successful operation in Great Britain. The 120 kw. station will be situated near Warsaw and will be used in addition to the 12 kw. Marconi station which has been in operation there since 1927. It will take the wave-length of the present 12 kw. station, which is 1111 metres; and the 12 kw. station will work on a lower wave-length. The two stations will be employed simultaneously for the transmission of alternative programmes. The two new 16 kw. stations will be situated at Lemberg and Vilna to provide programmes for the areas outside the range of the lower-powered station at Warsaw. Of the three local relay stations, one will be situated at Lodz, the Polish Manchester, 80 kilometres from Warsaw, to provide an alternative crystal programme for a working-class district. Arrangements are being made for alternative programmes to be available from Warsaw before the end of this year, and the whole scheme is expected to be in operation before the end of 1930.

THE incidence of a further period of drought in south-east England directs attention again to the generally dry character of this year, especially in the Midlands and south-eastern portions of England. According to a statement issued by the British Rainfall Organization (Air Ministry), for the eight months January to August, small patches with half the average rainfall, or less, are found in Nottinghamshire, east Lincolnshire, round about the borders of Berkshire and Hampshire, and in the east of Kent. An area with less than 60 per cent of the average runs as a belt across England and Wales from Cardiganshire to east Kent, but whereas the belt is narrow at its ends, it broadens out considerably in the middle. To the south and south-west of this belt, the percentage values range from 70 to 88 along the south coast, east of Devonshire; to 85 in Pembroke, and to 92 per cent in south-west Cornwall. Another area with less than 60 per cent of the average surrounds the dry patches of Nottinghamshire and Lincolnshire. Between the two areas with less than 60 per cent the percentage values fail to reach 70 per cent except in North Wales, where they just exceed 80. In the north of England the percentage values are generally somewhat in excess of 70, and surpass 80 locally in north Cumberland and the North Riding of Yorkshire. In Scotland the percentage values for the eight months appear to vary between 70 to just above 90 per cent; in Ireland they range from a little more than 70 to just above 100 per cent in the west of Galway. For the country as a whole the dry weather cannot be compared as yet with that of 1921, when for the nine months February to October less than 50 per cent of the average was recorded over the whole of south-east England and a considerable part of the southern Midlands. However, September and perhaps later months also have still to be reckoned with, and it is premature to make a final pronouncement.

IN a paper read before Section E (Geography) of the South African Association for the Advancement of Science at its meeting in August, which is printed in the Johannesburg *Star*, Dr. Percy A. Wagner made an interesting contribution to the problem of the pre-European miners and smelters of South Africa. The ancient gold industry of Southern Rhodesia is well known, but it is less commonly known that the

Katanga district of Belgian Congo formed, with central and Southern Rhodesia and the north-eastern Transvaal, the greatest ancient copper fields, whilst tin was most extensively mined in the Roolberg district of the Transvaal, and iron was worked over a large part of the area. A map showing the distribution of the ancient workings was exhibited, it being explained that these ancient mines, characterised by a high degree of mining skill, are clearly distinguished from the rough native workings of the last few centuries. Nearly all the gold and most of the copper mines of the present time in South Africa are on the site of old workings.

OVER a large region, from Katanga to Zimbabwe, the copper ingots found were of the astragalus type usually associated with the Phœnicians. At least a million tons of copper and 2000-3000 tons of tin must have been extracted. Since so little has been found in the finished state, the product must have been mainly exported, and Dr. Wagner is of opinion that these mines were the chief source of the copper, bronze, and gold of Egypt, India, and western Asia. Dr. Wagner maintains that the ruins of Zimbabwe and elsewhere are the temples of the race which conducted the mining and smelting operations. The bronze and copper of the Waterberg district contain notable quantities of nickel, an element which is also characteristic of the copper of Egypt and Mesopotamia. A bangle from Zimbabwe is a true tin bronze containing nickel, and as no tin is known in Southern Rhodesia, it is presumed that the bronze came from Waterberg. The case presented by Dr. Wagner will no doubt receive criticism on several grounds, but the new facts are of great interest.

WHEN a future generation comes to setting down the history of the growth of scientific method in anthropology, few names will have a claim to rank higher than that of the late General Pitt-Rivers. Both in the study of development in material culture and in archæological investigation, he elaborated methods which lie at the foundation of all the work of the last forty or fifty years. Record of his own work is preserved not only in the magnificent volumes upon which he lavished time and money, but also his methods and theories are embodied in material form in the Pitt-Rivers Museum at Oxford and in the Pitt-Rivers Museum at Farnham. Further, in the latter the visitor may see both the objects which were discovered by his excavations in Cranborne Chase and elsewhere, and side by side an exact record of the excavations themselves. Carefully executed models show the sites before excavation and the completed result. The general purpose of the Museum at Farnham is to illustrate the life of peasant communities. Costumes, furniture, pottery, arts and crafts, and agriculture each have rooms devoted to their exhibition. This, however, does not complete the tale of the collection. One room is devoted to the objects excavated in the neighbourhood, and there are in addition the ethnographical objects collected by Pitt-Rivers after his earlier ethnological collections had gone to Oxford. These include the famous collection of Benin bronzes.

AN excellent and well-illustrated "General Handbook" to the collections has recently been published, which may be obtained from the Museum. It is edited by Mr. L. H. Dudley Buxton, who has been engaged in the rearrangement of the collections. He also contributes several descriptive articles. Others are by Mr. H. St. George Gray, who for ten years was secretary and assistant in the museum. He writes a biographical note on General Pitt-Rivers and describes the models of the excavations. Dr. Harrison writes on pottery; and Dr. R. R. Marett describes the ceremonial objects. Mr. F. Ll. Griffiths contributes a note on an Egyptian 'tombstone'. A chapter on the "Ancient Inhabitants of Farnham and its Neighbourhood" by the editor is in the nature of an excursus on continuity in English life and culture, and incidentally it is an object lesson on the right orientation of a local museum. The present owner, Capt. Pitt-Rivers, has generously thrown open the Museum for a vacation school in anthropology of which the first session was held last Easter. For this purpose no better instrument of instruction than the collections could be desired.

IN a Shaw Lecture delivered at the Royal Society of Arts and published in the Society's *Journal* for Aug. 30, Sir Thomas Legge, formerly H.M. Senior Medical Inspector of Factories, reviews his thirty years' experience of industrial maladies. The progress during this period has been amazing, due to notification, prohibition, and regulation in the industries concerned. Phosphorus poisoning in the form of 'phossy jaw' in match-making has disappeared owing to the substitution of sesqui-sulphide of phosphorus for yellow phosphorus. The incidence of anthrax has been halved by the application of disinfection of wool and hair and the use of exhaust fans in the factories. Lead poisoning has been reduced to less than half among white-lead workers and painters, owing to the recognition that the poison is absorbed by the lungs and the adoption of measures to prevent its inhalation. Skin cancers are relatively common among certain tar and pitch workers and cotton mule spinners, but in the early stages are curable, so that periodical medical examination would result in a considerable saving of life, and incidentally in the cotton industry a saving of a considerable part of the £10,000 now paid in compensation. With new industries new risks develop, and during the last few years carbon disulphide and hydrogen sulphide poisoning have occurred in connexion with rubber and artificial silk.

THE University of London Observatory at Mill Hill Park will be opened and the Wilson telescope unveiled by the Astronomer-Royal, Sir Frank Dyson, on Oct. 8 at 3 P.M.

AT the sixth annual conference of the Association of Special Libraries and Information Bureaux held at Cambridge on Sept. 20–23, Sir J. J. Thomson was elected president of the Association in succession to the late Sir Geoffrey Butler.

THE inaugural sessional address of the School of Pharmacy of the Pharmaceutical Society of Great Britain will be delivered on Oct. 2 by Prof. Henry

lurd Rusby, professor of materia medica in the ollege of Pharmacy, University of New York, when ıe Hanbury Gold Medal of the Pharmaceutical ociety will be presented to Prof. Rusby. A note on rof. Rusby's life and work appeared in NATURE of une 1, p. 845, in announcing the award of the Hanury Gold Medal.

MR. F. D. OMMANNEY, Mr. F. J. Hart, and Mr. A. H. aurie have been appointed to zoological posts on ıe scientific staff of the Discovery Committee. Ir. Ommanney has already left England to undertake rhaling investigations with Mr. J. F. G. Wheeler at ıe Marine Biological Station, South Georgia. Mr. aurie is joining the R.R.S. *William Scoresby* at Cape 'own, and Mr. Hart will sail towards the end of the ear in the R.R.S. *Discovery II.*

APPLICATIONS are invited for the following appointents, on or before the dates mentioned :—A full-me head of the Mechanical and Electrical Engineerıg Department of the Harris Institute, Preston—'he Principal, Harris Institute, Preston (Oct. 1). ın assistant in the Mechanical Engineering Departıent of the Coventry Municipal Technical College—'he Director of Education, Council House, Coventry)ct. 1). A head of the Pharmacy Department and full-time assistant lecturer in engineering at the ardiff Technical College—The Principal, Technical ollege, Cardiff (Oct. 5). An inspector under the lkali, etc., Works Regulation Act, 1906—The irector of Establishments, Ministry of Health, 'hitehall, S.W.1 (Oct. 5). An Astley Cooper assistant to the Curator of the Gordon Museum of Guy's Hospital Medical School—The Secretary to the Astley Cooper Trustees, Medical School Office, Guy's Hospital, S.E.1 (Oct. 7). A research assistant in engineering applied to glass technology, in the Department of Glass Technology of the University of Sheffield, and research fellowships in glass technology in the same department—The Registrar, The University, Sheffield (Oct. 14). An assistant in botany in the University of Aberdeen—The Secretary, The University, Aberdeen (Oct. 15). An assistant professor in electrical engineering at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, South Kensington, S.W.7 (Nov. 1). A technical assistant in the Physics Department of the British Boot, Shoe, and Allied Trades Research Association—The Director of Research, British Boot, Shoe, and Allied Trades Research Association, 19 Bedford Square, W.C.1. A full-time lecturer in mathematics at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A woman lecturer in education in the department for the Training of Teachers of the University of Reading—The Registrar, The University, Reading. A lecturer and adviser in veterinary science in the Harper Adams Agricultural College and National Institute of Poultry Husbandry—The Principal, Harper Adams Agricultural College, Newport, Salop. A Principal of the Derby Technical College—The Secretary to the Derby Education Committee, Education Offices, Becket Street, Derby.

Our Astronomical Column.

Comets Neujmin and Forbes.—The following elements of these comets have been computed by Dr. . C. D. Crommelin; the first from observations on ug. 4 and 31 (Königstuhl) and Aug. 15 (Lick); the econd from photographic observations at Johannesurg by H. E. Wood on Aug. 3, 8, 13. The equinox 1929·0; T is in U.T. :

	Neujmin.	Forbes.
T	1929 June 28·922.	1929 June 26·619.
ω	140° 45′ 50″	260° 18′ 39″
Ω	158 15 53	25 5 38
i	3 40 23	4 39 34
ϕ	35 38 12	33 51 12
log q	0·309227	0·185458
eriod (years)	10·7914	6·4370

lmost identical elements of Forbes's comet were ound by Dr. R. T. A. Innes using the same observaons. He notes that they indicate a close approach Jupiter at the aphelion passage of 1920. There is slight resemblance to the elements of Barnard's omet 1884 II. A period of 5·4 years was found for , but it has not been seen since its first apparition.

The Discovery of Proxima Centauri at Johannesburg.—An account is given in the Johannesburg *Star* of ug. 24 of the circumstances which led to the disovery of the sun's nearest stellar neighbour. It is mphasised that the discovery was no fluke, but that r. Innes, noting other cases of distant companion ars, had an inspiration that Alpha Centauri might ave such a companion. The circumstances recall rof. W. H. Pickering's successful search for Phœbe, ıe distant satellite of Saturn; in that case also there as a sort of inspiration that such a body existed.

There were to hand the photographs of the region taken by Mr. Franklin Adams at the Cape in 1902, and similar photographs taken with the same instrument at Johannesburg in 1910. Further, a blink microscope for comparing star plates had been procured for the Observatory in 1915. At Dr. Innes's request, Mr. Wood took a further photograph of the region in 1915, under exactly the same conditions as the 1910 one. Comparing these plates, Dr. Innes quickly detected a faint star that had changed its position very obviously in the interval of 5 years; further examination showed that its motion was very nearly equal and parallel to that of Alpha. The connexion was further established by the determination of the parallax of Proxima, both at Johannesburg and by Dr. Voute. In the last few months a further determination has been made by Dr. Alden at the Yale station at Johannesburg; these determinations all agree in indicating that the distances of Alpha and Proxima are nearly the same, the latter being slightly nearer to us; the distance from Alpha is so great that the period of revolution must be of the order of a million years; but there is little doubt that Proxima and the two components of Alpha form a connected system.

General Perturbations of Minor Planets by Jupiter.—E. de la Villemarqué, *S. J.*, has computed tables of the perturbations by Jupiter of a large number of minor planets: he is now engaged on the planets whose mean daily motion lies between 1250″ and 1350″. *Astr. Nach.*, 5654, contains the first instalment for these planets. The labour of keeping up the positions of more than 1000 planets is so heavy that any tables that shorten the work deserve a hearty welcome.

Research Items.

Marriage in Africa.—From an extended study of the principles of Bantu marriage, Mr. E. Torday in *Africa*, vol. 2, No. 3, draws certain conclusions as to its essential features and directs attention to their practical bearing. In the present state of our knowledge, Bantu marriage appears to be the marriage of one man and one woman for the begetting of legitimate children in whom one of the two souls of the parents is perpetuated, and these will, after their parents' death, perform for them the rites and offer to them the sacrifices on which their happiness in the world of spirits depends. This is based upon a contract between two freely consenting adults whom it binds to conjugal fidelity on pain of temporal and spiritual penalties. It is indissoluble and liable to be extended beyond the grave by proxy if necessary to secure offspring. This arrangement has been disturbed by polygyny, which has affected the balance of the sexes, withdrawing a number of nubile females from the marriage market, and lowering the marriage age, leading further to a deterioration of sexual morals and adultery and divorce. 'Earnest', originally a symbol, is assuming more and more the character of a price on the bride. In its practical aspect this has led to a legal recognition of polygyny and a lower age for marriage than Bantu custom sanctions. Infant betrothal should be forbidden by law; nor should the growth of lobolo be allowed to pass unchecked into purchase money.

Chippewa Customs.—*Bulletin* 86 of the Bureau of American Ethnology is a study of the Chippewa by Frances Densmore, a number of whose valuable monographs on the music of different Indian peoples have already appeared in the publications of the Bureau. The writer first began her studies of the Chippewa in 1915, when she visited the villages on the north shore of Lake Superior, and since that date further material has been collected both in Canada and Minnesota on different occasions up to 1925. The present monograph covers the religion, social life, and technology of the Chippewa. Their name, Chippewa, is comparatively modern, and though it is the only name which has been used by Government in its relations with the people, is never that used by themselves; they still use the name Ojjibeway, or the older term A'nicina'be, meaning 'the original or first man'. They are described as a pleasant people with a strong sense of humour. Their industrial life was characterised by co-operation between men and women, the men taking the heavier part of the women's work, and the women assisting in the lighter part of the men's work, such as the making of canoes. Even the children assisted in such parts as they were able to perform. They maintained a high standard in their work, and those who excelled were honoured. Marked skill was held to be of supernatural origin. They early came into contact with white civilisation, and of them it was recorded that they "cultivate corn and potatoes to a limited extent, but devote most of their time in quest of food in the chase or in fishing". Their tribal history is recorded in the traditions of the Midewiwin (Grand Medicine Society) traced down from one generation to another. There are records of a migration from the great salt waters of the east, westward to the place where Montreal now stands, then to the shores of Lake Huron, and finally to La Pointe (Superior), where the Lodge was erected for the last time before the coming of the whites.

A Census of Gannets.—Several estimates, based upon different grounds, have been made of the number of solan geese or gannets which breed annually upon the Bass Rock in the Firth of Forth. The estimates have given numbers varying from 5600 to 10,000 adult birds, a fairly wide range. The first actual count of the gannets is described and discussed by Dr. James Ritchie in a recent issue of the *Scottish Naturalist* (p. 127). It was made by one of the light-keepers during the present summer, and revealed the presence of 4047 gannets' nests, representing 8094 adult breeding birds. In addition, 100 pairs were nestless owing to the raids of herring gulls—which gives a total adult breeding population of 8294 individuals. It is suggested that although the gannet population may have varied from year to year through the centuries, various factors make it probable that at present the numbers are at their greatest.

Migrations of British Woodcock.—In the days of the older naturalists, emphasis was laid upon the migrations of British woodcock, although it was admitted that occasional individuals remained over winter in Great Britain. Nowadays the ringing method of following the movements of birds has thrown the emphasis upon the woodcock which remain throughout the year in the British Isles. As a result of an analysis of the recaptures of ringed woodcock, Dr. Landsborough Thomson finds that perhaps only one-third of Scottish and North English birds migrate, and that the number recaptured on their native ground, often after a lapse of several years, is a striking feature of the data (*British Birds*, September, p. 74). There is a regular autumn movement from Scotland to Ireland, and also to France and Spain. About 95 per cent of the recovery records relate to the first four years of life, but it is interesting to find that one individual had reached the age of 12½ years before it was shot, while a few others ranged from 8 years to 12 years old. There is no positive evidence that migrant woodcock return to their native localities; indeed one individual ringed in Ireland was found, when two years old, in southern Norway.

Californian Echinoderms.—The second Bingham Oceanographic Expedition collected some very interesting echinoderms, including seven species of starfish, nine species of echinoids, three of ophiurans, and one holothurian ("Echinoderms from the Gulf of California and the Perlas Islands", by Lee Boone. Scientific Results of the Second Oceanographic Expedition of the *Pawnee*, 1926. Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University, vol. 2, art. 6, December 1928). These are described with beautiful photographic illustrations. Perhaps the most valuable capture was the large holothurian belonging to the Synaptidæ, presumably to be attributed to the West Indian species *Euapta lapha* (J. Müller). Three specimens were taken at night from Hidden Harbour, Lower California, each bearing 15 tentacles and having anchor plates which are identical with those of specimens taken at Porto Rico. Other distinctive finds are the big urchins *Meoma grandis*, only known from the Gulf of California and West Mexico, the peculiar *Encope grandis*, the 'key-hole urchin' of the Gulf of California, of which 23 specimens were taken, *Encope californica* with its five ambulacral foramina and one posterior foramen, and *Astropyga pulvinata*, one of the Diadematidæ. This last species is rare, and the *Pawnee* material appears to be the first record from Conception Bay.

Phylogeny of the Primate Placenta.—In a study which has covered the examination of 31 specimens

f 5 species of New World and 7 species of Old World monkeys, G. B. Wislocki has obtained evidence that he placentæ of the *Simiæ* exhibit various arrangements in structure which show them to be different nd yet to possess certain definite relationships Carnegie Institution, *Contributions to Embryology*, ol. 20, No. 111, 1929). He concludes that the lower atarrhines exhibit an architecture of the placenta ntermediate between the platyrrhines and the nthropoids, a sequence of development which would gree with that based upon comparative anatomy. A survey of the literature of mammalian placentation uggests that the majority of the mammals which are rchaic or are not far removed from the direct line f descent possess deciduate placentæ, whereas the nimals which possess a diffuse type of placentation re amongst the most extremely specialised mammals. his suggests that the deciduate type of placenta is robably the most primitive and that the diffuse lacenta is a specialised offshoot from it. The proto-lacentals themselves were derived from oviparous orms, so that naturally there must have been a period f transition from oviparity to viviparity, during which diffuse apposition of the membranes to the uterine nucosa might well occur. But recent placentals, as vell as their fossil prototypes, do not derive the liffuse condition of their placentæ from such primitive ransition forms. They appear to be quite independ-ntly and secondarily derived from mammals which ossessed penetrating trophoblast.

Leaf Growth in the Giant *Euryale*.—The circular loating leaves of *Euryale ferox* vie in size with those f *Victoria regia*, the largest being a metre and a half n diameter. According to Yonosuke Okada (*Sci. Rep. Tôhoku Imp. Univ.*, **4**, 361-368; 1929), their orizontal extension takes place in less than nine days, nd the rates of growth may therefore be exceptionally igh, even for water plants. Measurements indicate hat the leaves may increase in diameter by more than cm. in an hour, giving increases in area of 100-150 q. cm. per hour, for the period of most rapid growth. The growth rates are fairly uniform during both day nd night, although tending to be higher during the lay. The ratio mass/area decreases as the leaves et older.

Chromosome Linkage in *Œnothera*.—A further study f chromosome arrangement during meiosis in *Enothera* has been made by F. M. Sheffield (*Proc. Roy. Soc.*, B, **105**, 207-230; 1929) with particular eference to linkage in a series of F_1 hybrids with ourteen chromosomes. Most of the chromosomes vere arranged in a ring with a variable number of ree pairs. Non-disjunction was frequent, being ob-erved in about 9-12 per cent of the examples. In further consideration of the available data, the uthor points out that wild species of *Œnothera* have ither a large amount of pairing or more commonly large amount of linkage, the mutants and hybrids eing generally intermediate, though the type of inkage found in *Œ. Lamarckiana*, a ring of twelve nd a single pair, is by far the most common. His nalysis of these data shows that chromosome con-iguration in hybrids is the same as that of the pollen arents in seven cases, and as the seed parents in five ases. In one example, both parents and hybrids vere alike, while in the remaining fourteen cases the ybrids differ from either parent. It is pointed out hat these figures are not contrary to the supposition hat chromosome linkage is inherited, the whole roblem of linkage and its bearing on the genetic eculiarities of *Œnothera* being fully discussed.

Natural Distillation of Oil-Shale.—The possibilities of oil-shale seem to be infinite, judging from the vast literature devoted to it, but the following presents an unusual though not exactly new view-point. A well drilled on the north flank of Wheeler Ridge, south end of San Joaquin Valley, California, penetrated a considerable thickness of oil-shale. Of the many oil and gas shows in this well, all were confined to the shale belt. The zones of oil production in the main part of the oilfield concerned correspond approximately in stratigraphic position with the shale development described, and accordingly the question arises as to whether by natural distillation the oil obtained in the producing area is not directly derived from the lateral shale instead of from deeper lying beds, as commonly imagined. If Mr. H. W. Hoots has made his case for this possibility good, and there is certainly something to be said for his theory; then his remarks (*Professional Paper* 154-E, 1929, p. 173, United States Geological Survey) are worthy of notice and debate: "It would appear that if typical oil-shale will yield petroleum under natural conditions which have prevailed since its deposition, any stratigraphic zone of oil-shale or other highly organic rock, whether of marine or lacustrine origin, and even though entirely devoid of recognisable fossils, should be considered an adequate source of petroleum deposits in areas where overburden has been great or where deformation has been intense".

Mean Sea-level.—During the last two years, studies of mean sea-level have been carried on in New York waters under the direction of the National Research Council of the United States. Prof. D. Johnson has communicated a preliminary statement of the results to the *Geographical Journal* for September. Jamaica Bay, on Long Island, was selected for the study, the object of which was to test the theory that along an irregular coast mean sea-level is an irregular surface the precise elevation of which varies with changes in the form of the shore. Results showed the tidal range to be greater within Jamaica Bay than in the more open Lower Bay adjoining. They also show mean sea-level to be higher in Jamaica Bay than in Lower Bay, and the plane of sea-level to be higher at the north-eastern than at the southern and western stations. Prof. Johnson feels that the results support the view that distortions of the mean sea-level may be inferred from a consideration of the physiography of a given shore line. A full report is promised shortly.

Thames Floods and High Tides.—A report on the Thames floods of January 1928, by Dr. A. T. Doodson, and meteorological conditions associated with high tides in the Thames, by Mr. J. S. Dines, are the two papers published in *Geophysical Memoir*, No. 47, issued by the Meteorological Office. It appears from an exhaustive analysis of water-levels and meteorological conditions during recent years that the conditions under which the water-level rises by 4 feet or more above the predicted level at Southend are clearly defined. They are the onset of a geostrophic wind over a considerable part of the North Sea of 60 m.p.h. or more from between north-west and north. Within seven to sixteen hours, such an onset is likely to be followed by a considerable rise in water-level. A westerly wind with no north component over the extreme southern North Sea is no bar to a raised water-level so long as the requisite north-west to north wind occurs over other parts of the area. A favourable prior occurrence appears to be either a westerly gale off the west of Ireland and Scotland which veers or dies away before the onset of the wind over the North Sea, or a southerly gale over the North Sea preceding the northerly wind. During fifty years, only one serious flood has occurred. This is because

the rise above the predicted level only causes floods when it coincides with high spring tide. It has been found that the abnormal rises tend to occur at half tide, when they can do no harm. The reason for this avoidance of full tide has not been discovered, but its existence very materially reduces the liability to serious floods.

Sound Vibrations.—The issue of the *Journal de Physique* for May contains an article by M. Z. Carriére, of the Catholic Institute of Toulouse, on the study of the movements of the air when transmitting a sound wave. The air in a metal tube 3·5 cm. diameter and 170 cm. long is set into vibration by a telephone diaphragm which closes one end, the other being also closed. Fine dust can be blown into the tube and can be illuminated through a window in the side of the tube near the middle of its length. A microscope of low power allows the points of light produced by the dust particles to be observed through a second side window. When there is no obstruction in the tube the particles describe straight line paths parallel to the axis of the tube of length varying from 0·15 mm. to 1·8 mm. according to the current used to operate the telephone diaphragm. When a cylinder is present in the tube with its axis at right angles to that of the tube, the paths near the surface of the cylinder are small ellipses with their long axes in the direction of the stream lines in the motion of a perfect fluid past the cylinder. As the amplitude of the motion increases, these ellipses become pointed as they approach the plane through the axis of the cylinder at right angles to the axis of the tube.

Volta Effect.—From time to time Prof. Oscar Scarpa, of the Royal Milan Polytechnic, has carried out theoretical and experimental investigations on the Volta effect, with the object of applying to it present-day knowledge of the chemico-physical constitution of metals and alloys. At the meeting of the Reale Istituto Lombardo di Scienze e Lettere on April 11, he gave a preliminary account of certain phenomena observed in circuits composed entirely of metals. With reference to the first part of Volta's law relating to the potential differences developed at the contacts of different metals, Prof. Scarpa finds that if a chain of metals includes some capable of mutual reaction, the order of arrangement is not without influence on the magnitude and sign of the potential difference between the extremes. Thus, although with the system copper-mercury-copper-zinc-copper zero potential difference results, this is not the case with copper-copper-mercury-zinc-copper. As regards the second part of Volta's law, it is not correct to state merely that, with heterogeneous metallic chains having any given temperature, the terminal potential difference depends solely on the chemico-physical nature of the component metals. A necessary condition for this to hold is that all the metals in contact must be indifferent one to the other.

Spectrum of Krypton.—The July issue of the *Journal of Research* of the United States Bureau of Standards contains a paper by W. F. Meggers, T. L. de Bruin, and C. J. Humphreys on the arc spectrum of krypton. This had not previously been described satisfactorily, largely, it would appear, because of the difficulty of distinguishing between the lines of krypton and those of xenon. Some two hundred lines are listed, and the majority of these have been fitted into term schemes, which, as would be expected, are similar to those of neon and of argon. This investigation was undertaken primarily in order to test the possibility of using the krypton line at 5650 A. as a standard of wave-length in place of the red cadmium line. The term analysis actually shows that the former involves a metastable state of the atom, so that it is unsuited for this purpose, although a stronger krypton line at 5871 A. is free from this objection, and is to be re-examined for hyperfine structure. The paper includes a bibliography of earlier work upon the spectrum of krypton, and good reproductions of the arc spectrum between 3300 A. and 9751 A.

Preservation of Metal and Timber in Sea-Water.—The committee of the Institution of Civil Engineers which is investigating the deterioration of structures in sea-water has issued its ninth Interim Report, published by H.M. Stationery Office for the Department of Scientific and Industrial Research (London. Price 3*s*. 6*d*. net). The Report follows the same lines as its predecessors, being occupied mainly by records of the loss of weight and extent of pitting of specimens of iron and steel exposed in various situations. Dr. J. N. Friend describes the bars which have been exposed for five years at Plymouth and Colombo respectively, the corresponding sets exposed at Auckland and Halifax having been reported on last year. In general, the four sets are in fairly good agreement. Completely immersed specimens show less difference than those exposed to alternate wet and dry conditions, whilst aerial exposure gives the greatest differences between the best and the worst specimens. Nickel has a marked effect in lessening the corrosion of steel, and highly alloyed steels are very resistant, although steel with 13 per cent of chromium is badly pitted when continuously immersed. The alloy steels do not happen to be very typical of the corrosion-resisting steels of the present day, this being a consequence of the long period necessarily occupied by such trials. It cannot be said that the tests have brought to light anything very novel, and they will be best interpreted in the light of the scientific work on corrosion now being conducted with so much success. The effect of various paints and coatings is still under investigation, and the results of this work will be useful. Prof. G. Barger reports on the protection of timber by impregnation with arsenical poisons, and finds that low concentrations give insufficient protection against *Teredo*, whilst uniform impregnation is not easily effected. *Limnoria* is proof even against the highly poisonous arsenical preservatives, but certain woods appear to be immune from its attack.

Canadian Hydro-electric Development.—The development of hydro-electric power in Canada continues to make rapid progress. The mid-year review of the Department of Water Power and Reclamation Service, just issued by the Minister of the Interior at Ottawa, shows that during the first six months of 1929 new undertakings completed and additions made to existing installations have totalled an aggregate of almost 200,000 horse-power. The undertakings at present in hand, when completed to the limit of their designed capacity, will produce more than two million horse-power. As was stated in an article which appeared in NATURE of July 27, p. 130, the total hydro-electric horse-power actually developed in the Dominion is now about 5½ millions. Activity is particularly notable in the provinces of Quebec and Ontario, where several important enterprises are being prosecuted. The only province in which progress is not marked is Prince Edward Island. The laying of transmission lines is an outstanding feature, including a second 220,000-volt line from the Gatineau River to Toronto and a 132,000-volt line across New Brunswick.

Freshwater Fauna of the Malay Peninsula.

By CEDRIC DOVER.

VERY little is known of the freshwater fauna of the Malay Peninsula, though the late Dr. N. Annandale, the father of freshwater biology in the East, extended his studies outside Indian limits. A beginning is, however, being made in Malaya, as the institution of a series entitled "Papers on Malayan Aquatic Biology" in the *Journal of the Federated Malay States Museums* proves, and it is the object of this note to indicate the general interest of the subject.

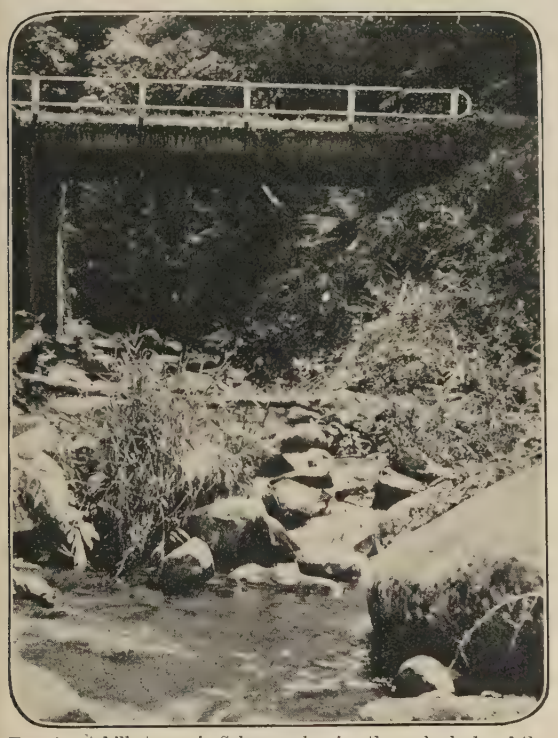

FIG. 1.—A hill-stream in Selangor showing the rocky bed and the quiet areas formed by the rocks.

Comparing the Malayan freshwater fauna with that of India, one is struck with its poverty from the viewpoint of specific variety. Insects, of course, are abundant, particularly the aquatic Rhynchota (of which a very large and thorough collection has been made), mosquitoes, dragon-fly and various neuropterous larvæ, and coleoptera, especially the Hydrophilidæ and Gyrinidæ. Such groups as the fishes and tadpoles, however, though they occur in Malayan ponds and streams, are not abundant either specifically or individually, while molluscs are rare, and only one polyzoon, and no hydrozoa or sponges, has yet been found.

In the hill-streams the surface fauna consists entirely of water-bugs of the family Hydrometridæ, particularly the long-legged striders of the genera *Ptilomera* and *Metrocoris*, with occasionally one or two species of gyrinid beetles which swarm in the quieter areas at the edges. There are no other visible planktonic organisms. Below the surface the only fauna, except in still areas caused by a large boulder or a bend in the stream where fishes are found in some abundance and a few Notonectidæ sometimes occur, is that attached to stones and rocks on the bottom. This fauna consists chiefly of the larvæ of certain mayflies, dragonflies, and Pyralid moths, and the curious tadpoles of the genus *Megalophrys*. Among vegetation at the edges, or among rocks in the quieter parts (Fig. 1), prawns and, more rarely, molluscs of the genus *Melania* may sometimes be seen, while leeches are often abundant enough to be troublesome.

The fauna at the source of the stream presents little essential difference from that found in its lower reaches, and the fauna of any one stream, on the west coast at any rate, is similar to that of any other stream, even though they be widely separated in distance. This is not surprising, for physico-chemically nearly all these streams are similar, their hydrogen ion concentration, for example, being always in the immediate neighbourhood of the standard of neutrality, while their temperature does not as a rule vary by more than two or three degrees Centigrade. Their rate of flow is usually very swift and the food supply afforded by them is so scarce that much specific variety cannot be expected, for only a few species, prolific in reproduction and having a short life-history, can establish themselves in these streams. The well-established forms are therefore characterised by an abundance of individuals, the collector often being able to obtain a few hundred specimens of such species as the hemipteron *Perittopus breddini* with a single sweep of the net. But while the fauna of Malayan hill-streams is poor, it is of absorbing interest, and this very poverty, combined with the abundance of easily accessible streams, would facilitate intensive studies along the lines of Annandale and Hora's work in India and Dodd's researches in America.

FIG. 2.—A swamp on the outskirts of Kuala Lumpur, divided off by Chinese agriculturists, showing nature of vegetation.

Turning to the biota of still-water areas, we find the same comparative paucity of species so far as the animals and higher plants are concerned, but a rich

algal flora. In the ponds the aquatic Rhynchota are also the most conspicuous organisms, being represented by all the known families, especially the Gerridæ, Microveliadæ, Notonectidæ, (*Plea* and *Nychia* especially), Corixidæ (*Micronecta* only), and the smaller Belostomatidæ (*Sphærodema rusticum*); the Nepidæ are comparatively rare. Coleoptera, mostly Hydrophilidæ, are quite common, while dragon-fly and dipterous larvæ, chiefly those of the Culicidæ and Chironomidæ, and shrimps, are usually abundant. Molluscs are rare, though occasionally a dirty Chinese duck-pond may be found in which Ampulariidæ, Viviparidæ, Milaniidæ, Limnæidæ, and Planorbidæ occur in fairly large numbers. Nematodes and oligochætes are scarce, and the polyzoa, hydrozoa, and sponges are entirely absent. The microscopic fauna is abundant, though not very varied, the Entomostraca being particularly common. Rotifers occur in some numbers, and there is generally a rich Protozoon fauna, *Euglena* forming a thick scum on the surface of some ponds.

The algal flora is rich, especially in blue-green algæ and in desmids, but the higher plants are generally rare and are often absent. In some swampy ponds there is a dense growth of rushes, weeds, and grasses at the edges (Fig. 2), consisting of such species (kindly identified by Mr. R. E. Holttum) as *Enhydrias angustipetala* Ridley, *Limnophila erecta* Bentham, *Cyperus hespari* Linn., *Rhynchosphora aurea* Vah., *Tuviena umbellata* Rottb., *Scirpus mucronatus* Linn., *Mariscus microcephalus* Pusl., and *Eleocharis variegata* Kunth., while in others the water-hyacinth, *Eichornia crassipes*, is very common. *Pistia stratiotes* is also sometimes abundant, while below the water at the edges the bladderwort, *Utricularia* sp., and the peculiar star-shaped *Blyxa malayana* Ridley may often be found.

The specific paucity of the macroscopic pond biota may be accounted for by the fact that many of these ponds are situated in limestone, and are thus detrimental to the life of such organisms as molluscs or sponges, while the water is generally very impure and varies from extreme acidity to extreme alkalinity, owing usually to the proximity of Chinese dwelling-houses and piggeries.

Sponges are entirely absent, and so are Polyzoa, with the exception of *Plumatella emarginata* Allman, which I have taken in the Ampang Waterworks near Kuala Lumpur, where the conditions for Polyzoon life are ideal. But even *P. emarginata* is living on the edge of extinction, though it seems to have the inherent hardihood which enables an organism to stand a certain amount of what Grinnell, the American ornithologist, so aptly calls ecologic punishment.

Of other freshwater areas on the west coast of the Malay Peninsula there is little to say. There are no natural lakes, and the larger rivers, which are often fouled with the tailings from tin mines, have not been carefully investigated. It is well known, however, that they are infested with crocodiles, while the insect fauna is more or less similar to that of the hill streams. The fauna of the mouths of these rivers is essentially marine.

Ninth International Congress of Psychology.

THE ninth International Congress of Psychology met at Yale University, New Haven, on Sept. 1–7 under the presidency of Prof. J. McKeen Cattell. The attendance numbered 1089 professional psychologists, of which, however, only 122 came from countries outside the United States. But this is not surprising when it is remembered that more than one hundred institutions in the United States provide for psychology an annual budget of £1500 or more, and that for the larger universities this figure averages about £10,000, and reaches its maximum of £40,000 at Columbia.

The president, doyen of American psychologists, outlined the colossal development of the subject in the United States since the time, nearly fifty years ago, when he was a pupil of Wundt at Leipzig. Cattell's work on individual differences will always rank as an outstanding pioneer achievement in this field which is now so universally systematised. Tables were presented which showed the number of contributions by the psychologists of the various countries during particular periods, and, as might be expected from the foregoing remarks, they demonstrated the quantitative and financial superiority of the United States. More interesting would be tables showing what percentage of the total population in each country consisted of professional psychologists.

More than 470 papers were listed at the Congress, and they covered all the various cross-divisions of psychology: theoretical, experimental, comparative, social, educational, industrial, æsthetic, religious, legal, physiological, etc. Sessions were also devoted to special topics such as the effects of drugs, sleep, the psycho-galvanic reflex, the psychology of music, and the nature of *g*.

In addition to researches on traditional lines, there are at least two branches in the United States which at present are carrying on research at high pressure. The first is that of animal behaviour, which was represented by thirty papers at the Congress. Several of the chief universities, such as Chicago, Clark, Columbia, Harvard, Michigan, Minnesota, Stanford, and Yale possess well-equipped laboratories for comparative psychology, although it is yet too early to attempt an assessment of the importance of their numerous studies. One of the chief workers in this field is Prof. K. S. Lashley of Chicago, the present president of the American Psychological Association, whose address on "Basic Neural Mechanisms in Behaviour" was acknowledged as a masterpiece, and showed further that not all workers in this field can be classed as narrow-minded behaviourists.

The second branch which displays marked activity is that of child development, especially prominent being the child research centres of the Universities of Columbia, Iowa, Minnesota, and Yale. The mode of attack appears to be a co-operative study by psychiatrists, psychologists, physiologists, anatomists, bio-chemists, and statisticians armed with elaborate machinery. They work at a common centre, usually attached to a university. It may be true that many of the results obtained are already known in general terms to our clinical experts. Nevertheless, the careful tabulation by exact statistical methods may still be worth while and may well repay the labour and expense entailed and lead to results as important as they are unexpected. Certain it is that the American nation intends to leave no stone unturned in order to ensure that the rising generations and their successors will not lack any physical or mental benefit which modern science can supply.

Prominent amongst European leaders present at the Congress may be singled out Prof. I. P. Pavlov, whose public lecture, "A Brief Sketch of the Highest Nervous Activity", was lucidly interpreted by Dr. G. Anrep;

of. C. E. Spearman, whose noegenetic theories are adily gathering adherents, and Profs. W. Köhler and Koffka, who have gained many sympathisers for e *Gestalt* movement. Another German school which s in evidence at the last Congress at Groningen, mely, the *Erklärungs* group, was not represented the Congress, although it is still a force in Gerany.

A contribution which aroused lively discussion was of. W. McDougall's second report on a Lamarckian periment, the first report having been presented at e Oxford meeting of the British Association in 1926. s experiments have been in progress for several ars and are being continued. Definite problems re set to groups of white rats, that is, trained and ntrol groups. While the average error for the ntrol group was 165, this figure was reduced to 68 the thirteenth generation of the trained rats and adily diminished to 25 for the twenty-third generan. Prof. McDougall therefore concluded that the idence in favour of the Lamarckian hypothesis was ry strong.

The foreigners present were unanimous in their preciation of the wonderful hospitality of the nerican people and of the gracious manner in which at hospitality was extended.

In conclusion, it may be pointed out as significant at President James R. Angell of Yale, Prof. Cattell, d Prof. F. Claparède of Geneva, the secretary of the ternational committee of the Congress, in their openg addresses, all emphasised the part which the ngress has already played in cementing goodwill d peace amongst the various nations. An official dress of welcome on behalf of the United States vernment was given by Mr. William J. Cooper, mmissioner of Education.

Annual Exhibition of the Royal Photographic Society.

THE seventy-fourth Annual Exhibition of the Royal Photographic Society is now open and may be en until Oct. 12 at the Society's rooms at 35 Russell uare. The greater part of the work shown is torial. It would, however, be presumption on the rt of the present writer to discuss the merits of istic photography, and readers of NATURE may be pposed to take a deeper interest in the scientific d technical section of the Exhibition; it will erefore be sufficient here to direct attention to me of the more outstanding exhibits in the latter tion.

To say that photography is a method of recording means of light may be to utter a platitude, yet is exhibition pays a striking tribute to the amazing versity of the applications of photographic recording scientific and other work.

Archæology is well represented. The University Chicago Epigraphic Exhibition from Luxor shows ine photograph of a part of the wall of the Temple Medmet, together with the result obtained by inking d bleaching such a print. The scene depicted is at of Rameses III. advancing in battle against stile Libyans. No less interesting is a group of four urch roof bosses photographed by Capt. Cave, who s developed a special technique for dealing with ese dimly lighted, inaccessible subjects. These are, course, special applications of ordinary still otography, and there are many examples of the ne kind—map-making and aerial photography, ud photography, police records, and so on through a very wide field. Photographic methods may also be used to record the appearance of bodies in rapid motion, and we have long been familiar with photographs of athletes in the very act of moving, and such like subjects. J. A. Speed has devised a method for extending this kind of work to the photography of animals. By synchronising the firing of specially prepared magnesium flashlight powder with the working of the camera shutter, he has been able to obtain excellent photographs of some of the shyest animals. His pictures of a honey bee in flight, a swallow in flight, and a leaping stoat are indeed excellent.

Capt. Quayle shows some very fine photographs of objects moving even more rapidly—bullets in flight. Three 'stories' are illustrated. In one we are shown successive photographs of a charge of shot impinging upon a clay pigeon. In another series a hollow-pointed bullet is shown at various stages of penetration through a slab of paraffin. In the third is shown a bullet fired from a worn and rusty rifle. Friction in the barrel of the rifle has punctured the metal casing of the bullet and melted the lead inside. The spinning bullet goes forward throwing out a spray of molten lead through the hole in its side, much in the manner of a catherine wheel moving perpendicularly to the plane of its rotation.

A. G. D. West and the Research Department of the Gramophone Company show photographic records of sound waves. Such records are now used very extensively in the study of the acoustic properties of buildings. One of these studies concerning the echoes in the Albert Hall is illustrated.

Some phases in the manufacture of photographic materials are illustrated by two exhibits sent in by British firms. Messrs. Ilford, Ltd., show some of the materials which are used in producing a photographic film; samples of a photographic emulsion at various stages of manufacture are also shown. Messrs. Illingworth and Co., Ltd., show a working model of a machine for coating paper with a sensitive emulsion. The way in which hundreds of feet of paper are automatically coated, set, looped, dried, and rolled up in a continuous process seems beautifully simple when we see this model in action.

There are many excellent samples of photomicrography. Dr. L. C. Martin and F. Lucas both show photomicrographs of biological subjects taken with ultra-violet light. It is stated that by this method magnifications so high as 5000 diameters result in crisp brilliant images with a degree of resolution surpassing by far that achieved with any other known optical system.

One more exhibit may be mentioned. The Mount Wilson Observatory sends a photographic map of the infra-red solar spectrum. By means of neocyanine, plates have been made sufficiently sensitive to record lines of wave-lengths down to about 11,400 A.

S. O. R.

University and Educational Intelligence.

THE list of University Extension Lectures and University Tutorial Classes issued by the University of London is of interest mainly to students of literary subjects. Science, however, is not unrepresented: courses are to be given by Mr. J. C. Hill on psychology and by Dr. W. J. Perry on the history of religions, at Morley College; by Mr. F. Addey on general astronomy, at the Royal Crystal Palace Hotel, Upper Norwood; by Mr. G. C. Robson on progress and decline in animate Nature, at West Ham Municipal College; by Dr. A. Wilmore and Mr. A. N. Wilmore on various aspects of

geography, at Westminster Training College. Particulars of courses can be obtained from the University Extension Registrar, University of London, South Kensington, S.W.7.

We have received from the United States Bureau of Education a copy of its Biennial Survey of Education, 1924–26 (Washington, D.C.: Government Printing Office. 2.30 dollars). Half of the volume is a convenient compilation of studies, most of which have already appeared in the course of the past two years in the form of 'advance sheets', by members of the Bureau's departmental staff and other specialists, and the rest consists of statistical tables (general statistics, State school systems, city school systems, universities, colleges, and professional schools, teachers' colleges, public high schools, private high schools, and private commercial and business schools), representing the most important class of the Bureau's publications of 1927–28. Among the subjects of the special studies are: Trends in the development of secondary education, industrial education, commercial education, home economics, adult education, educational surveys, parent-teacher associations, educational boards and foundations, and education in foreign countries. Of special interest as evidence of enthusiasm for education and self-examination are the chapters on parent-teacher associations and educational surveys. The former shows a growth in membership of parent-teachers associations from a hundred thousand to a million in six years, and the latter gives particulars of a great variety of investigations, each having for its purpose the unbiased analysis of educational situations which may be used as bases for formulating programmes for improvement.

University matriculation requirements in the United States formed the subject of an investigation recently conducted by the professors of education at Leland Stanford Junior University and the State Teachers' College of Kansas. The field of inquiry included 331 colleges and universities and 977 high schools. The results of the investigation are reported in the April number of *School Life*. It was found that English was the only subject recognised by all as indispensable for candidates for admission to university courses. Some degree of proficiency in mathematics is required by 96 per cent of the institutions reporting, in social science by 77 per cent, in a foreign language by 75 per cent, and in laboratory science by 54 per cent. Of the women's colleges only 25 per cent require science, whilst 74 per cent require Latin. Among the conclusions resulting from the investigation are: there is a wide demand for the restatement of admission requirements in terms allowing more latitude as regards subjects offered, and ousting mathematics and foreign languages, in particular, from their privileged position; an increasing minority of those concerned view with favour the relatively new ideas of grading candidates with reference to results of intelligence tests and reports on such personality traits as industry, reliability, judgment, cooperativeness, leadership, initiative, and physical vitality as well as average scholarship; much progress has been made towards harmonising the views of the high school principal and the university, through the appreciation by the latter of the necessity confronting the high school of meeting the needs of all its pupils and conforming its programme of studies to those needs. The articulation of university and secondary education will be further improved as a result of the general survey of secondary education recently authorised by Congress to be carried out in the course of the next three years.

Calendar of Patent Records.

September 28, 1799.—One of the pioneers of gas lighting was Philippe Lebon, to whom a French patent for "Nouveaux moyens d'employer les combustibles plus utilement, soit pour la chaleur, soit pour la lumière, et d'en recueillir les divers produits", was granted on Sept 28, 1799. No practical use appears to have been made of Lebon's apparatus for lighting purposes, but he established a tar factory near Le Havre which obtained some success.

September 29, 1842.—W. S. Henson was the first to design a heavier than air flying machine on the lines of the modern monoplane, a patent for his machine, driven by a steam-engine, being granted to him on Sept. 29, 1842. The aeroplane, known as the 'Aerial steam carriage', was well advertised in the Press of the period but was never actually constructed. Henson was assisted in his experiments by Stringfellow, who constructed a steam-driven model aeroplane—now in the Science Museum—which was the first machine to fly under its own power.

October 1, 1852.—Up to 1852, the procedure for obtaining a patent for an invention in England was the same as that prescribed for any other grant under the Great Seal, and involved, after the Petition had been lodged, separate visits, with the appropriate fees in each case, to the Secretary of State's office, the Attorney or Solicitor-General, the Signet Office, the Privy Seal Office, and the Chancery Patent Office, and the subsequent enrolment of the grant and of the specification. By the Patent Law Amendment Act which came into force on Oct. 1, 1852, one office was provided for all stages of the grant, a single patent was obtainable for the whole of the United Kingdom, and all specifications were printed and made readily available to the public.

October 2, 1608.—Though he cannot be called the first inventor of the telescope—for these were known previously though more or less only as scientific curiosities—Johann Lipperhey, spectacle maker of Middelburg in Holland, who on or before Oct. 2, 1608, applied to the States-General for a privilege for thirty years, or alternatively for the grant of a pension in respect of the invention, must be given the credit of being the first to make telescopes commercially, and from him dates the realisation of their importance and their practical application. Fifteen days after Lipperhey's petition and while this was still pending, a similar application was received from Jacob Adriaanzoon, and finally Lipperhey's application was refused on the ground that "many other persons had a knowledge of the new invention". Three instruments — binoculars — were, however, ordered from him, and he received 900 florins in payment.

October 2, 1839.—The earliest proposal to apply electricity to clocks and to provide a system of synchronised secondary clocks controlled by a standard clock was made by Karl August von Steinheil, who was granted a Bavarian patent for three years for the invention on Oct. 2, 1839, thus preceding by some months Alexander Bain and Sir Charles Wheatstone in England. A description of Steinheil's invention was published in the Munich journal *Kunst- und Gewerbeblatt* for 1843.

October 3, 1687.—On Oct. 3, 1687, a patent was granted to Joseph Mason for "an engine by the help of which a weaver may performe the whole worke of weaving such stuffe as the greatest weaving trade in Norwich doth now depend upon, without the help of a draught-boy". No description of the invention is available, but the services of the draw-boy were not finally dispensed with in figure weaving until the invention of the Jacquard machine in 1790.

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 26.—F. E. Fournier: bservations of the tour of the world by the *Graf ppelin*.—André Blondel: The calculation of the lls of potential of transformers of potential of ternating currents, when they require a strong xciting current.—William Bowie: Concerning ver- al prisms of the earth possessing the same mass.— eorges Giraud: Certain problems analogous to the oblem of heat.—Bernard Salomon: The gyroscopic nalogies of mutual induction and of magnetic losses. Maurice Roy: Propellers with limited vein and roude's ideal propeller.—Vasilesco Karpen: Can the axwell-Clausius relation be demonstrated without course to Carnot's principle? Reply to criticisms Verschaffelt.—Eduardo Mª Galvez: The fall of otential in electrical generators.—J. Dourgnon and Waguet: Calculation of the illumination produced non-point sources, radiating according to Lambert's w and of constant brightness.—Jean Lugeon: The nesis of heat storms and their prediction with the d of [wireless] atmospherics. From a curve showing e number of atmospherics per minute, the particular nd of heat storm common in Switzerland can be edicted one or two hours in advance.—Carl Störmer: etarded echoes [in wireless telephony]. In an earlier mmunication the author attributes the echo to flection at surfaces of electrified particles in space tside the moon's orbit. The hypothesis of the istence of such surfaces was first put forward to xplain observed phenomena in connexion with rora borealis. Further cases of wireless echoes scribed by various observers are cited, and a con- xion is shown between the angle ψ (angle be- ween the direction earth–sun and the equatorial agnetic plane) and the echoes. With one exception the echoes were noted when the angle ψ was all, $+4{\cdot}3°$ to $-9{\cdot}0°$, but negative results were tained when ψ was large ($-31°$ to $33°$). Sugges- ons are put forward for further international ob- rvations.—A. Guichard: The ontogeny of the getative leaf of *Carex glauca*.—A. Hée: The in- ence of cold waves on the respiration of plants. r old leaves, exposure to cold is followed by a arked increase of the respiratory intensity. For ung leaves, a slight fall of temperature below 0° C. uses a diminution of the value of respiration. The odifications in the respiratory intensity produced by w temperatures are temporary, the respiration coming normal when the temperature is maintained ove 0° C.—R. Bonnet: The evolution of nitrogen ring germination.—J. Lemarchands: Researches the transformations, and more especially on the ponification of the reserve fats in seeds during ger- nation. The first change in the fatty reserves is a ponification and there is no preliminary oxidation the glycerides: the oxidation of the free fatty ids starts with the unsaturated acids.—Jean Roche: me physico-chemical properties of natural globin. Sept. 3.—H. Vincent: The pathogenic effects ercised on man and animals by the neurotrope otoxin of *Bacillus coli*: description of symptoms various types of intoxication by this toxin, me of which could only be identified as due this poison by the fact that anticolibacillus serum to an immediate cure.—Eugène Flutsky: Some opositions on stochastic limits.—G. Vranceanu: emann spaces having their coefficients of rotation nstant.—Hasso Harlen: Some properties of en- mbles.—N. Lusin: A general principle of the theory analytical ensembles.—A. Kovanko: A class of arly periodic functions which give rise to the classes of $p.p.$ functions of W. Stepanoff, H. Weyl, and Bezicovitch.—R. Jungen: Remarks on a theorem of M. Hadamard relating to the multiplication of singularities.—L. Rosenhead: The alternating vortices of Bénard-Kármán in a canal of finite width.—Henri Villat: Observations on the preceding note.—P. Delanoë: The Moroccan spirochætes of the Ornithodores from burrows and the spirochæte of Mansouria are not recurrent in man. They constitute a distinct species of the Spanish spirochæte, *Sp. hispanicum*. In Morocco there are at least three spirochætes pathogenic for man, *Sp. recurrentis*, *Sp. hispanicum*, and a non-recurrent spirochæte, *Sp. marocanum*.

BRUSSELS.

Royal Academy of Belgium, Dec. 1.—Th. De Donder: The rôle of affinity in undulatory mechanics. —Constant Lurquin: A limit theorem for probability in the sense of Bienaymé-Tchebycheff.

Dec. 13.—J. E. Vershaffelt: The practical determination of surface tension by the method of separation of discs. A simplification of the method of calculating the surface tension from the experimental results based on the use of successive approximations. —Boutaric and Mlle. G. Perreau: Study of the pH coefficients producing flocculation of an arsenic sulphide sol and a ferric hydrate sol.

Dec. 14.—Victor Willem: The architecture of bees. —Armand Renier: Belgium in the Carboniferous period.

Jan. 5.—Th. De Donder: The invariantive theory of the calculus of variations.—L. Godeaux: Certain cyclic involutions belonging to algebraic curves.— Lucien Godeaux: The envelope of the Lie quadrics of a surface.—Jean Baudrenghien: The preparation and properties of the 1 : 2 dimethyl-cyclopropanes. These hydrocarbons have been prepared by five different methods, which are described in detail.— E. Henriot: The dynamic magnitudes transported by light.

Feb. 2.—Th. De Donder: (1) Invariantive theory of the calculus of variations. (2) The principle of correspondence of the generalised Dirac undulatory mechanics.—M. Dehalu and P. Swings: Observations of Jupiter made at the Cointe Observatory.—L. Godeaux: The Wilczynski directrices and Lie quadrics of a surface.—E. Henriot: The possibility of representing the movements of energy by means of two waves of velocity c.

Mar. 2.—Edm. van Aubel: Magnetostriction in bismuth. Claim for priority.—Th. De Donder: Invariantive theory of the calculus of variations.— P. Martens: Experimental study of the sporocyte chromosomes in *Tradescantia*.—Mlle. L. de Brouckère: The adsorption of electrolytes by crystalline surfaces. Studies in the adsorption of the chlorides of cadmium, mercury, lanthanum, and lead by barium sulphate.— Y. Glivenko: Some points in the logic of Brouwer.— R. H. J. Germay: An extension of the Lagrange formula and its application to the solution of the equation of Gauss.

Official Publications Received.

BRITISH.

The Agricultural Department, Madras. Bulletin No. 94: Field Experiments with Calcium Cyanamide as a Nitrogenous Manure for South Indian Soils and Crops. By B. Viswanath and S. Kasinathan. Pp. 17. 4 annas. Bulletin No. 95: The Work of the Livestock Section. By R. W. Littlewood. Pp. 9+6 plates. 6 annas. Bulletin No. 96: Cultivation of Grape Vines. Pp. 6. 2 annas. Year Book, 1928. Pp. ii+66+8 plates. 14 annas. (Madras: Government Press.)

Mines Department. Seventh Annual Report of the Safety in Mines Research Board; including a Report of Matters dealt with by the Health Advisory Committee 1928. Pp. 88+2 plates. (London: H.M. Stationery Office.) 1s. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1230 (Ae. 385): Pressure Plotting a Streamline Body with Tractor Airscrew Running. By C. N. H. Lock and F. C. Johnson. (T. 2721.) Pp. 22+8 plates. 1s. net. No. 1234 (Ae. 389): Tests on Airship Models at Large Reynolds Numbers. By L. F. G. Simmons. (T. 2724.) Pp. 7+2 plates. 6d. net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 26: The Uranyl Oxalate Method of Daylight Photometry and its Photo-Electric Standardization. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 321-339. 1s. 6d. Vol. 19 (N.S.), No. 28: The Photo-Chemical and Photo-Electric Measurement of the Radiation from a Mercury Vapour Lamp. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 355-364. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1228 (Ae. 383): Full Scale Control Tests on Fokker F. VII 3M Monoplane. By J. K. Hardy. (T. 2715.) Pp. 8+7 plates. (London: H.M. Stationery Office.) 9d. net.

Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1927–28. Pp. 91. (London: H.M. Stationery Office.) 3s. net.

Department of the Interior: North West Territories and Yukon Branch. Yukon: Land of the Klondike. By F. H. Kitto. Pp. 45. (Ottawa: F. A. Acland; London: High Commissioner of Canada.)

Bulletin of the British Cast Iron Research Association. No. 25, July. Pp. 141-184. (Birmingham.)

Battersea Polytechnic, Battersea Park Road, S.W.11. Technical College for Day Students, and Day School of Art and Crafts: Calendar, Session 1929–1930. Pp. 47+12 plates. 3d. Domestic Science Department and Training College: Full Time Day Instruction, Afternoon and Evening Classes, Session 1929–1930. Pp. 34+7 plates. 3d. Department of Hygiene and Public Health, Session 1929–30. Pp. 25+3 plates. 3d. Calendar of Evening and Afternoon Courses and Classes for the Session 1929–1930. Pp. 31+9 plates. Free. (London.)

The Proceedings of the Physical Society. Vol. 41, Part 5, No. 230, August 15. Pp. viii+431-605+ix-xxiv. (London.) 7s. net.

Journal of the Indian Institute of Science. Vol. 12A, Part 7: i. Formation of Heterocyclic Compounds from Diethylxanthic Formic Ester, by Praphulla Chandra Guha and Devendra Nath Datta; ii. Ring Closure of Hydrazo-Monothiodicarbonamides with Acetic Anhydride; Formation of Iminothiobiazolones and Iminothioltriazoles, by Praphulla Chandra Guha and Tarani Kanta Chakraborty. Pp. 79-104. (Bangalore.) 1.4 rupees.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Professional Paper 144: The Copper Deposits of Michigan. By B. S. Butler and W. S. Burbank. Pp. xii+238+75 plates. 2.50 dollars. Professional Paper 154-B: The Fauna of the Middle Boone, near Batesville, Arkansas. By George H. Girty. (Shorter Contributions to General Geology, 1928.) Pp. ii+73-103+plates 9-12. 15 cents. Professional Paper 154-C: Salinity of the Water of Chesapeake Bay. By R. C. Wells, R. K. Bailey and E. P. Henderson. (Shorter Contributions to General Geology, 1928.) Pp. ii+105-152+plate 13. 15 cents. Professional Paper 154-D: Origin of the Siliceous Mowy Shale of the Black Hills Region. By William R. Ruby. (Shorter Contributions to General Geology, 1928.) Pp. ii+153-170+plates 14-16. 10 cents. Professional Paper 154-E: Oil Shale in a Producing Oil Field in California. By H. W. Hoots. (Shorter Contributions to General Geology, 1928.) Pp. ii+171-173+plate 17. (Washington, D.C.: Government Printing Office.)

Californian Agricultural Extension Service. Circular 29: Control of Pocket Gophers and Moles in California. By Joseph Dixon. Pp. 16. (Berkeley, Calif.)

University of California Publications in Zoology. Vol. 30, No. 14: Mammals collected by Charles D. Brower at Point Barrow, Alaska. By E. Raymond Hall. Pp. 419-425. Vol. 30, No. 15: Pterylography of certain North American Woodpeckers. By William Henry Burt. Pp. 427-442. Vol. 32, No. 2: The Avifauna of Emeryville Shellmound. By Hildegarde Howarde. Pp. 301-394. (Berkeley, Calif.)

Transactions of the San Diego Society of Natural History. Vol. 5, No. 16: Notes on the Marine Pleistocene Deposits of San Diego County, California. By Frank Stephens. Pp. 245-256. Vol. 5, No. 17: A new Miocene Echinoid from California. By Hubert Lyman Clark. Pp. 257-262+plate 21. Vol. 5, No. 18: Loliolopsis Chiroctes, a new Genus and Species of Squid from the Gulf of California. By S. Stillman Berry. Pp. 263-282+plates 32-33. (San Diego, Calif.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indië. Door Dr. C. Braak. Deel 11, Aflevering 3: Buitengewesten behalve Sumatra. (With English Summaries.) Pp. vii + 401-545 + 187-257 + 2 plates. (Weltevreden.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 193: On the Transition Probability between two States with Positive or Negative Energy in a Central Field due to Nuclear Charge *Ze*. By Y. Sugiura. Pp. 80. 1.00 yen. No. 197: On the Tautomerism of 2:5-Dithiopiperazine. By S. Ishikawa. Pp. 119-129. 25 sen. No. 198: The Near Infra-red Spectra of Helium and Mercury. By T. Takamine and T. Suga. Pp. 131-137. 20 sen. No. 199: A Study of the Helium Band Spectrum, III. By S. Imanishi. Pp. 139-149. 25 sen. (Tokyo: Iwanami Shoten.)

CATALOGUES.

Foster Optical and Radiation Pyrometers. (Book No. 45.) Pp. 44. (Letchworth: Foster Instrument Co.)

The Taylor-Hobson Outlook. Vol. 3, No. 14, September. Pp. 129-136. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Wild-Barfield Electric Furnaces for all Industrial Purposes. Pp. 10. (London: Wild-Barfield Electric Furnaces, Ltd.)

The Nickel Bulletin. Vol. 2, No. 3, September. Pp. 65-96. (London: The Mond Nickel Co., Ltd.)

Laboratory Fittings, including "Technico" Standard Unit Type Benches. (List F, revised August.) Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 27.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (in County Hall, March), at 11.30 A.M.—Capt. G. E. Mathews: The Drainage of the Fens.

INSTITUTE OF MARINE ENGINEERS (at Olympia), at 6.30.—H. Barringer: Modern Tanker Practice (Lecture).

INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield and District Section) (at King's Head Hotel, Sheffield), at 7.30.—G. L. Oxley: Presidential Address.

SATURDAY, SEPTEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Wisbech), at 10.30 A.M.—S. Matthew: Notes on the Borough of Wisbech.—R. S. W. Perkins: Notes on the Work of the Highways Department of the Isle of Ely, C.C.

TUESDAY, OCTOBER 1.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Miss A. Hibbert-Ware: Field Notes on New Zealand Birds.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—Prof. W. Morgan: The Member and the Institution (Presidential Address).

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8.—H. S. Ryland: Talking-Films.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—H. A. Sloman: A New Method for the Production of Pure Beryllium Oxide from Beryllium Ores.—R. Taylor: Isolation of Helium from Monazite Sand.

WEDNESDAY, OCTOBER 2.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. H. E. Cox: Chemical Tests in Relation to Fur Dermatitis.—J. H. Coste: Demonstration of a Nomogram for Use in Gas Analysis.—P. S. Arup: The Composition of Irish Winter Butter.—Dr. W. R. Schoeller and H. W. Webb: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. XVI. Observations on Tartaric Hydrolysis. XVII. The Quantitative Precipitation of the Earth Acids and certain other Oxides from Tartrate Solution.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, OCTOBER 3.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—W. J. Hadfield: Some Road Questions.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section), at 7.30.—Dr. H. Levinstein: Presidential Address.

FRIDAY, OCTOBER 4.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. J. Hill: Engineering Experiences on a Tea Estate in Assam.

SATURDAY, OCTOBER 5.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Dr. P. B. Ballard: A Talk about Modern Methods.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—E. A. Martin: Gilbert White and his Village.

ANNUAL MEETING.

MONDAY, SEPTEMBER 30, TO SATURDAY, OCTOBER 5.

BRITISH MYCOLOGICAL SOCIETY (at Bristol).

Monday, Sept. 30, at 8.—Reception by Prof. and Mrs. Darbishire.

Tuesday, Oct. 1, at 10 A.M.—Foray.
At 8.45.—Annual General Meeting.

Wednesday, Oct. 2.—Visit to Long Ashton Research Station.
At 8.45.—Miss E. M. Wakefield: Fungi Exotici: Past Work and Present Problems (Presidential Address).

Thursday, Oct. 3, at 11 A.M.—Foray.
At 8.—J. Ramsbottom: The Influence of Fungi on Life in General (Popular Open Lecture).

Friday, Oct. 4, at 11.30 A.M.—Foray.
At 8.45.—Carleton Rea: Comments on the Finds of the Week.

CONFERENCE.

OCTOBER 10 TO 12.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS (at Connaught Hall, Newcastle-upon-Tyne).

Thursday, Oct. 10.—Dr. H. Mess: Tuberculosis on Tyneside: a Sociological Study.
Dr. E. Rist and others: The Factors that produce Pulmonary Tuberculosis.

Friday, Oct. 11.—Dr. W. Brand: A Scheme of National Propaganda regarding Tuberculosis.
Dr. A. H. Macpherson: Combined Treatment and Technical Education of Tuberculous Youths.
Dr. T. Beattie and Dr. F. Hewat: The Teaching of Tuberculosis to Undergraduates.
Dr. W. H. Dickinson: The Training of Tuberculosis Medical Officers
Dr. H. Williams: Methods of Medical Propaganda regarding Tuberculosis.
Dr. W. Guy: Dentistry in Relation to Tuberculosis.

NATURE

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Editorial and Publishing Offices :

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No. 3127, VOL. 124]

Scientific Books and Libraries.

WHEN the Goths overran Greece, so Montaigne relates, "the only thing that preserved all the libraries from the fire was, that someone possessed them with an opinion that they were to leave this kind of furniture entire to the enemy, as being most proper to divert them from the exercise of arms and to fix them to a lazy and sedentary life". Although an author and a 'bookworm', Montaigne himself confessed that he preferred the stimulus of conversation and debate to the "languishing and feeble motion" of the study of books, of which incidentally he too had seen examples "made of things that were never either studied or understood". One wonders how the Goths would have behaved, or what classical tag the French essayist would have quoted, had either been invited to catalogue, arrange, and house, if never to use, only that portion of the scientific literature of the nineteen-twenties that is generally admitted to be of permanent value. It is, however, idle to prophesy, for has not Mr. Belloc told us that a prophecy (when it is scientific) is always and invariably absolutely and totally wrong ?

In any event, scientific authors do not write books with the intention of pleasing or amusing, although both results have been known to follow their efforts, but with that of recording, of instructing, of stimulating inquiry by the offer of new bases, fresh views, or even the galvanism of polemics. In other words, scientific books and journals are intended to be the servants of the multitude rather than the friends of the few.

Desirable as they might individually be, a rabble of undisciplined servants would be of little use ; informative as they might separately be, a motley collection of ill-arranged, ill-catalogued, and ill-indexed books or inadequate abstract journals would do little more than represent a considerable waste of money and effort. The subject of the training of librarians for special libraries was discussed by Mr. A. F. Ridley, of the British Non-Ferrous Metals Research Association, at the recent conference at Cambridge of the Association of Special Libraries and Information Bureaux (ASLIB). When it is remembered that a chemical library, for example, has to accommodate and classify journals containing original records of research, dissertations, patent specifications, treatises and handbooks, abstracts, reviews, indexes, bibliographies, dictionaries and encyclopædias, tables and catalogues, some of broad outlook and others of narrow scope, and that the

custodian of the books is also the mentor of their readers, the specialised yet comprehensive character of his charge becomes apparent. There are said now to be appearing more than twelve hundred journals which publish at least an occasional paper of chemical interest; when to this total are added publications other than of the journal class, and the whole is then extended to include other sciences, the dimensions of modern scientific literature can be appreciated.

In every section leaders of the scientific army help us to digest the mass by summaries and criticism; abstract journals and indexes help us to follow closely the course of development in a particular direction; reports summarise the abstracts; monographs engrave the milestones and label the route; books and articles portray its attractions; some of us run in the race and others are clerks of the course, whilst many contrive successfully, often brilliantly, to combine the two rôles.

So hot has the pursuit become, so rapidly are records made and broken, that sooner or later the cry of standardisation had to be raised. Scientific men, individualists as they are in many ways, are at pains to introduce uniformity into their methods and their observations, but the librarian finds insufficient uniformity in the presentation of their published records. From the utilitarian aspect, from the point of view of the research worker or the teacher, no less than from that of the custodian, this lack of uniformity is a disadvantage which is worth analysis and some measure of co-operative agreement.

This matter also was dealt with at the Cambridge conference of ASLIB. Dr. Wilfrid Bonser discussed the ideal form in which, from the librarian's point of view, a journal should be produced. Dr. Bonser would be the first to agree that the importance lies not so much in the convenience of the library staff, although this is by no means to be overlooked, as in the fact that what the librarian can arrange correctly and catalogue accurately can be the more quickly and completely rediscovered by the user. He indicated, for example, the difficulties which an unfortunately selected title, an inconsistent size, or an inappropriate division of articles may cause. He referred to inconvenience arising from certain practices involving title-pages, contents, and index, and mentioned absurdities which irregularities in the time of appearance may produce. The price of journals is also of general concern. So far as it affects scientific periodicals collectively, the matter has reached a somewhat acute stage.

It has long been impossible for more than the fortunate few to maintain a scientific library with any pretence to adequacy, and it has now become necessary for most important libraries to allow financial considerations a measure of precedence over scientific requirements. Scientific workers, although usually securing for themselves little material profit from their investigations, generally finance on some co-operative plan the publication of their own work, so that the results of their studies may freely serve as the starting-point for the work of others; moreover, they generally find it necessary to purchase in addition reports of the work of other groups, as well as to subscribe to journals and other serial publications of ordinary business enterprise. Thus both the individual worker and the librarian, budgeting within definite, although widely different, limits, dislike violent fluctuations in price and—having for a few years subscribed to a new journal at a moderate price—particularly resent the demand for ever-increasing subscriptions for parts issued at irregular and always more frequent intervals. It is fair to add that the object of Dr. Bonser's criticism is not a British publisher.

Another paper which was read at the same conference, by Mr. H. Rottenburg, was concerned with the indexing and classification of 'one-man' collections of data. The object of the discussion was not, of course, to attempt to lay down rules, for in his methods of acquiring and preserving information perhaps more than in many other characteristics one man differs from another. The paper did, however, disclose methods which, in various hands, have proved advantageous and made suggestions which will doubtless prove acceptable. The hints which Mr. Rottenburg offered ranged from types of bookcases and the vagaries of loose-leaf binders to the use of the decimal classification.

Both the Association of Special Libraries and Information Bureaux and the Library Association have found it necessary to direct attention to the serious deterioration of documents and printed matter in public record offices and libraries, and it is satisfactory to know that steps are being taken with the view of securing the permanence of such records in the future. A committee has been appointed to consider the formation of a panel of expert translators, and the possibility of procuring greater uniformity in the size of journals is being canvassed. The report on the year's work of the Association included reference to the inquiry bureau, to the bulletin and directory, and to plans for the publication of a catalogue of the London borough libraries and the Guildhall library.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Australoid Element in the Korannas.

In a short paper which I published six years ago on the craniology of the yellow-skinned races of South Africa, I pointed out that the Hottentots and Korannas seemed to me to be very distinct from the Bushmen. The former have dolichocephalic skulls and are well-built men, often of tall stature : the latter are a small race with skulls that are nearly brachycephalic. The Hottentots of south-west Africa, and the Korannas of the Vaal River valley, while apparently branches of the same race, have certain distinguishing characters. The typical Hottentots are not improbably the primitive race contaminated by a considerable Bush-

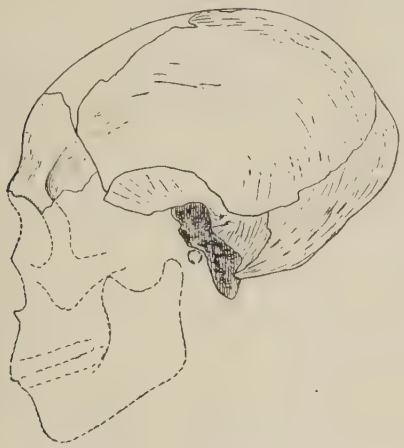

Fig. 1.—Orthoprojection of Australoid skull from Barkly West, South Africa. One quarter natural size.

man admixture ; while the Korannas are apparently nearer to the primitive type, but with a considerable Australoid element.

A few months ago, the discovery of the Springbok skull revealed to us the fact that many thousands of years ago there lived in South Africa a large-brained powerfully built race which was neither Bushman nor Bantu, and a race which in all essentials resembles the living Korannas so closely as to leave little doubt that the Korannas are the descendants, somewhat degenerate and somewhat mixed with another race. In my paper I suggested the possibility of contamination by *Homo rhodesiensis*. Whether later discoveries will confirm this suggestion there can now be little doubt that a race has lived in South Africa with a skull which with a low brow and well-marked supraorbital ridges recalls in many ways the Neanderthaloids and the Rhodesian man.

A skull has just been discovered by Mr. G. J. van Alphen, magistrate at Barkly West, near Kimberley, which though very imperfect seems well worthy of description. The fragments of the skull were got in a deep alluvial bank at Canteen Kopje. The fragments obtained are the practically complete occiput, most of the left parietal, much of the left frontal, parts of both temporals and fragments of the right parietal, and some fragments of limb bones. As no jaws or teeth were found, it seems unlikely that the remains are from a grave. The bones are much mineralised and certainly old, but there is no satisfactory evidence to decide how old. Most probably they are much more recent than either the Boskop skull or the Springbok skull.

Fortunately, the fragments of the left side of the skull enable us to make a complete restoration of the brain case. The occiput is very long and moderately flat, and the parietals exceptionally large. As a result, the part of the skull behind the plane of the ear is unusually large. The frontal, on the other hand, is low and relatively narrow and there is a very large but thin and flat supraorbital ridge. The antero-posterior measurement of the skull is 205 mm., and the greatest breadth about 140 mm. ; the basi-trigmatic height is estimated to be also about 140 mm. The greater part of the temporal is preserved on one side or the other, so that it can be restored with confidence. The mastoid process is exceptionally well developed.

The face is entirely lost except for the upper margin of the left orbit, but as the position of the auditory meatus is certain, the face can be restored with some probability.

When the whole skull is restored it is seen to be very unlike that of the Bushman or Bantu, and only a little like that of the typical Koranna. Most probably it is the skull of a representative of the early Australoid race of South Africa, or possibly a Koranna in which the Australoid characters are unusually prominent.

In the absence of the face, it is scarcely safe to discuss the affinities further, but this skull, when added to the other early types already known—the Rhodesian, the Boskop, and the Springbok—shows that our craniological problem is by no means a simple one. R. Broom.

The Original Home and Mode of Dispersal of the Coconut.

Almost simultaneously with the publication of my article under this title in Nature of July 27, Dr. John K. Small, head curator of the Museums, New York Botanical Garden, published an article on " The Early History of the Coconut Palm " in the *Journal of the New York Botanical Garden* for July (vol. 30, p. 153), which reached Kew on Aug. 9.

The early history given by Dr. Small is adapted from a letter received from the late Dr. William E. Safford, a well-known authority, and it is of interest to find that he considered there seems to be no evidence pointing to the probability of its American origin.

Beccari has pointed out, as I have indicated, that the American species of *Cocos* are not nearly related to *Cocos nucifera* and that it is more closely allied to *Jubœopsis Caffra* of South Africa than to any of the so-called *Cocos* of South America. In his interesting paper, " The Origin and Dispersal of *Cocos nucifera* " (*Philip. Jour. Sci.*, **12**, Bot. pp. 27-43 ; 1917), to which I regret I did not refer in my article, he brings forward very conclusive facts against the suggested American origin of the coconut. Beccari also, from the evidence afforded by the Palmyra Islands, Cocos-Keeling, and Krakatau, produces convincing proofs that the coconut can germinate when washed ashore on coral atolls or sea beaches without human aid.

The historical points referred to by Dr. Safford, which are published by Dr. Small, seem to be worthy of wider attention, so I have extracted those of most importance.

" The supposed *Cocos* from northern South America observed by Cieza de Léon (born 1518), which through an incorrect translation was considered to be *C. nucifera*, must have been a genus of palms closely

related to *Attalea*. No early writer, so far as can be ascertained, regarded the coconut as native of America. Piso (born 1596) expressly says it is exotic, while Aublet (born 1729) states it was introduced into Guiana by missionaries. Père Breton (born 1609), a French missionary in the Antilles, planted a coconut in his garden and called it 'Palm', saying it had no other name in the West Indies, for it was an introduced species, and Hans Sloane (born 1660) said the same.

"Hernandez (born 1514), who was sent on a mission to Mexico in 1575, speaks of the coconut as growing on the west coast of tropical Mexico; and instead of enumerating its uses in Mexico he speaks of its various applications in the Philippines. Dr. Safford saw it growing at Acapulco, Mexico, the port from which the early Spanish galleons sailed to the Philippines and to which they returned with Philippine products, none of which were easier to transport than coconuts. At this port the natives now slice off the tips of flowering branches and let the sap flow into receptacles through tubes of bamboo, exactly as is done in the Philippines. More than this, 'tuba', the name given to the fermented sap by the Mexicans, is the name used for it in the Philippines and in Guam.

"Acosta (born about 1539), in his Natural History of the Indies, 1590, says that he saw a coconut growing in Porto Rico; but he does not pretend to say that it was indigenous there. Indeed we know well that Columbus and his companions, who were quite eager to find East Indian products in the Antilles, did not observe the coconut growing there. On the other hand, throughout the islands of Polynesia the coconut is called 'niu', a name identical with the 'niug', or 'niyog', of Guam and the Philippines. The Polynesian name can be traced, together with the nut, directly to the Malay Archipelago, the cradle of the Polynesian race.

"On the Polynesian Islands and in the Malay Archipelago there are a great many varieties known by distinct names, differing from one another in the forms of the nuts and in the uses to which they are applied. No such diversity of forms and uses is to be found in America, where indeed there is not a single distinctive name for the species. In pre-Columbian times it was referred to by Marco Polo (born about 1254), and by other travellers, not as *coconut* but as *nux indica*, a fact to which many authors who have discussed the coconut do not refer."

Ludovico di Varthema, who travelled in the East, between the years 1503 and 1508 (Hakluyt Soc., p. 163), enumerates ten useful things yielded by the tree "Tenga" (the coconut), and mentions with regard to the fermented juice that "it will affect a man's head by merely smelling it, to say nothing of drinking it!" His account clearly indicates the antiquity of the coconut in Calicut.

With regard to Dr. Safford's suggestion that coconuts were probably carried to America in the Spanish galleons which made regular voyages to Acapulco, this would seem to have been most likely, since the coconut would certainly have been taken as an article for food on the voyage.

As Merrill has pointed out (*Philippine Jour. Sci.*, **7**, No. 3, p. 198; 1912), the introduction of many plants of economic importance, both to America from the Philippines and in the reverse direction, can be definitely traced to these galleons, and it seems reasonable to assume that coconuts so brought over were planted by the Spaniards, and their advent in America may be traced both to this means of transport as well possibly as to ocean currents.

ARTHUR W. HILL.

DR. ARTHUR W. HILL has suggested to me that the following notes on the native names mentioned in his article in NATURE of July 27 will be of interest.

(1) *Niur*. Coconut. The gestures of tongue and lip which produce this word are:

N. Tongue tip elevated to close against the palate, and held closed during phonation through the nasal cavity.

I. Tongue tip slightly dropped to the high and forward vowel posture of *I* (as in eat or ? it) so as to produce a *small* front cavity between tongue and lips.

U. Lips protruded, lip opening reduced, tongue lowered and humped towards the back of the throat, so as to form an elongated hollow mouth cavity.

R. Tongue tip raised and curved back (the edges of the tongue-tip being in contact with the palate).

If this series of gestures be considered as an unconscious mouth-pantomime, originally associated with a general bodily pantomime which described the idea to be conveyed, then:

Niur would appear to mean: Up (or high, or touching the top)—little (or high)—hollow (or elongated hollow)—curved (or bent back). A "high up—little (or high)—rounded-hollow" would be a fair (primitive) description of the coconut.

Niu, nu. These would then mean up—little (or high)—hollow, and up-hollow respectively. They may, of course, be simply abbreviations of *niur*.

(2) *Kuku, kukuma*, and *khukum*. Crab. *Ku*, like *u*, is a common gesture word for hollow; it also (in many languages) means (the hollow of the) hand. Thus: Cantonese *ku* to shut around, *kü* to grasp, the Aryan root *ku* to strike, the Sumerian *ku* to throw.

The initial *k*—made by a 'plosive' release of the tongue closure at the back of the throat—seems commonly to denote the beginning of a forcible action. Hence *kuku* would naturally mean to stretch out forcibly like a hand—as we might say grab-grab (cf. the English word crab).

In *kukuma* the penultimate *m*—made by closing the lips and *holding* them closed (during phonation through the nasal cavity) means to *hold* closed. Hence *kukuma* means grab-grab-hold-tight; the final *a*, if significant, would mean down, that is, grab-grab-hold-tight-down.

(3) *Kelapa, kelambir, kaluku*. Coconut. *Kel* and *kal* have the forcible release *k* followed by the tongue-lifting gesture of *el* or *al* which very commonly denotes up. Compare Polynesian *ala* rise, Indonesian *al* sun, Hoka *al* sun, Doric Greek ἄλιος sun, Latin *altus*. Also *al* in native names for mountains; for example, *Alps*, Ural, Himalaya—and various names for God, heaven, etc. (meaning on high), in many unrelated languages. *Ap, amb*, and *ku* are all gestures of closing or seizing; the terminal *a* of *kelapa* may, as before, mean down.

Hence *kelapa* may mean forcibly-up-seize-down. *Kelambir* would mean forcibly-up-hold-tight—high (or little)—bend-back (or curve). *Kaluku* would mean forcibly-up-hollow-hold.

It will be seen that all these three words are appropriate to the gestures of going up to take the coconuts.

(4) *Kukur*. Claw. *Kuku* means grab-grab, the terminal *r* means back or bent back, the word then means grab-grab-bent-back.

It is evident that if the mouth gesture of *ku* may signify either hollow or grab, there is no need to postulate a direct connexion between *ku* in words for coconut and *ku* in words for crab.

In conclusion I am tempted to refer, on my own account, to a native name for a vegetable product mentioned in NATURE of Sept. 7, namely, *copal*, the Mexican word for resin.

Cop (*kop*) is another gesture word meaning hollow

or enclose. Compare English *cup*, *cob* (corn, or nut), *coop*, *coomb*, *cap*, *cape*, *keep*; Latin *copia*, *caput*, *cum*, *capio*; the Semitic roots *H-p-n*, *g-H-p*, and *K-m* meaning handful, take, quantity; Sumerian *kam* earthen jar, *gab* breast; Cantonese *kap* imbibe, *káp* jaws, *kam* grasp, *kòp* a measure; Bantu *-k'apo* sack; Polynesian *kapu* cup; Indonesian *kabo-k* goblet; Hoka (North American) *kupo* basket; Arawak (South America) *kabo* hand, *komiki* bowl.

Al, as we have seen, means up, on high; *copal* therefore naturally would mean cup-up, that is, the vessel fastened *up* the tree to collect the resin.

R. A. S. Paget.

1 Devonshire Terrace, W.2,
Sept. 8.

Adaptation.

The present-day attitude with respect to adaptations is peculiar and to my thinking unscientific. Adaptation implies duality, an interaction between the organism and the environment. The descriptions of outstanding examples of the relationship are made in dual terms. But there the implication ends, for biological creed steps in to forbid it.

The younger biologists have been brought up in a genetic school which will not allow of such an interaction between circumstance and life. The protoplasm is possessed by a series of gods which determine what the protoplasm is to do. Variations are due to these gods and the relative degree of power they are able to develop. Let us take two examples. A blind and colourless animal is found in conditions of darkness because a section of the gods in its ancestors were producing inferior eyesight and diminishing pigment. A white animal chooses an Arctic environment because the gods of the germplasm gave it a colour suitable to such circumstances.

(1) In 1903 (Northumberland Sea Fisheries Committee. Report on the Scientific Investigations, p. 51) I described the occurrence of *Gammarus duebeni* in the Mill Pit at Blyth. From that account it will be seen that the amphipod lives in drains near the pit head and is liable to be carried into the pit when flooding takes place. The pit was flooded in 1887 and in 1899. The gammarids were first observed in 1893 (and were called by the men 'pit fish') in the landward workings, but they were carried by the drainage water into the second drift. The fact of time and the circumstance of a large increase in numbers about 1898 when the drainage water was dammed back for the use of the stables, show that they breed in the new environment.

The examples I obtained in 1901–2 had a dull transparent white colour, and the three red spots were absent. They were apparently blind so far as simple tests could testify. The colour was gradually regained under laboratory conditions, the degree of restoration depending upon the intensity of the light and successive ecdyses. The first exuviated cuticle was white and the second yellow to light brown in colour. The red spots appeared also and, at first very faint, gradually increased in strength of colour.

The variation therefore is reversible. But it is in this respect of importance. If, during the life of an individual still able to undergo ecdysis the stimulus of light is capable of restoring the pigment and probably the function of the eyes, it is evident that the original change was also direct and affected all the individuals successfully introduced to the conditions. In neither case is the germ plasm involved. The life in a state of darkness and the subsequent exposure to light produce results which are due simply to stimuli and the cessation of stimuli on protoplasm. After the first event of breeding of similar variants, the first generation would be exposed to the conditions of darkness from the egg-stage and the effects would be intensified. The next generation would arise from parents still more completely colourless and blind. The pit is liable to receive fresh contributions from the surface which would tend to delay the change; but even so it is evident that it would progress to a stage when restoration would be more difficult, when, instead of a succession of ecdyses, one or more generations would be required.

This is not the only case of the kind. More than sixty years ago Thomas Atthey sent to my predecessor examples of a copepod which were obtained from the damp roof of the pit workings of a colliery at Cramlington. Brady described it originally as a new species, but later identified it with Sars' *Canthocamptus pygmæus*. The references will be found in Brady's Ray Society monograph under the name *Attheyella pygmæa*. Brady said nothing about the pigment, but the queried 'eyes wanting' is significant.

It may be urged, and rightly, that the effects of the one and the other environment are just what would be expected. The variations result from the nervous capacity of protoplasm and are not inherited. They depend upon the sustained condition of the cause. But this consideration gives rise to a feeling of misgiving as to what is meant by heredity. It is plainly difficult to say where non-inheritance ends and inheritance begins. If the circumstances confine the reproduction to a section of the population, the members of which are all similar variants, then a direct inheritance results without the germ plasm being called upon to do more than start a history which is affected in similar degree in every generation. This is what might be called a conditioned or passive sexual selection. But it must be remembered that an active sexual selection is generally exhibited and has been in operation since conjugation was instituted.

Whether the change is to be inherited depends upon circumstance. An annual ring is not inherited. This brings us to the other example, the Arctic animals.

(2) It is already obvious that a similar explanation can be given in the case of northern terrestrial animals. They are affected by the seasonal alternations of heat and cold, the degree of the modification depending on temperature. The whitest of them all, the polar bear, becomes more yellow in summer and progressively white in winter. No one now seriously believes that the origin of the change had anything to do with colour protection. A physiological explanation of the change is apparent, and inheritance is assured, for all the members of the species exposed to the conditions would be similarly affected.

I beg to submit, therefore, the proposition that all adaptive variations are psychogenetic and that they are directly inherited under asexual conditions of reproduction and by the action of sexual selection in the sexual state.

A. Meek.

Aug. 29.

Distribution of Potential Temperature in the First 25 Kilometres over the Northern Hemisphere.

In his communication in Nature of June 15, p. 906, Sir Napier Shaw has emphasised the fundamental importance of a knowledge of the distribution of entropy in the atmosphere for an understanding of the physics of the general circulation.

In Fig. 1 is drawn a smoothed diagram (similar to Sir Napier Shaw's diagram on p. 116 of his "Manual of Meteorology", vol. 2) showing the latitudinal distribution of potential temperature in summer and winter of the northern hemisphere. The potential temperatures plotted (in degrees absolute) are

temperatures which the air at any place would assume if compressed or expanded adiabatically to 1000 mb. The temperature data used in the calculation are the same as those employed in preparing the diagram of temperature distribution over the earth (see NATURE, June 1, p. 834), and the monthly mean surface pressure data at the places of sounding balloon observations are taken from the isobaric maps given in pp. 218-241 of the book quoted above. The values obtained from the results of a few sounding balloon ascents over Poona (lat. 18° N.) during the winter of 1928–29 have also been used. As is well known, lines of equal potential temperature are also lines of equal entropy.

It is possible that potential temperatures over north India during the summer are exceptionally high and that the trough near Lat. 25° N. will be less marked if more data from similar latitudes in other parts of the world are available.

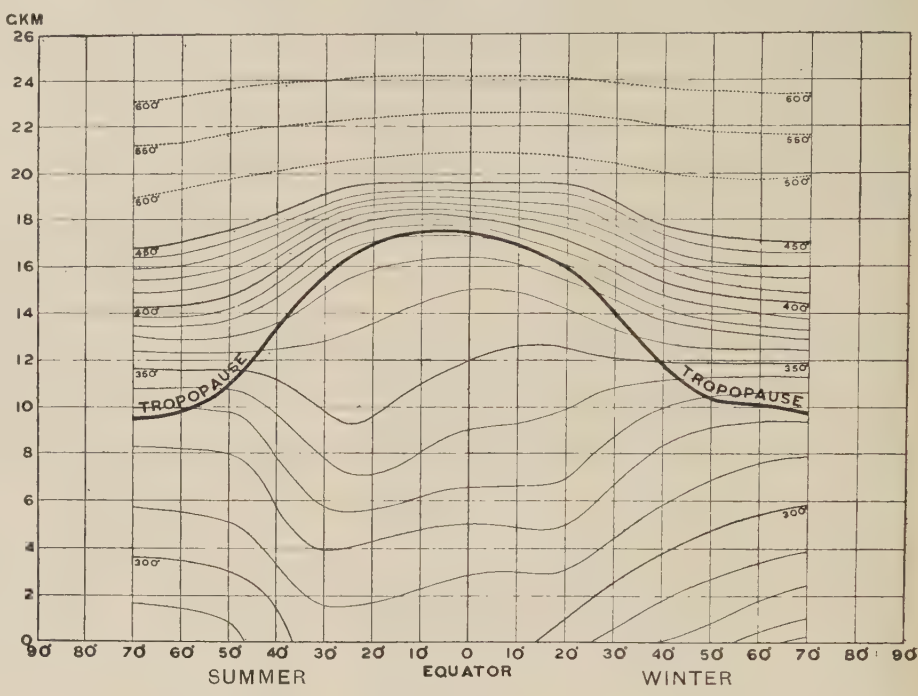

FIG. 1.—Upper air potential temperatures over the northern hemisphere.

Two interesting features (also partially shown in Sir Napier Shaw's diagram) may be pointed out:

1. The dip in the isentropics over the tropics and sub-tropics below about 12 gkm., their elevation between 12 gkm. and 20 gkm., and their pronounced concentration between 17 gkm. and 20 gkm., especially during the summer, suggest that these features are causally connected.

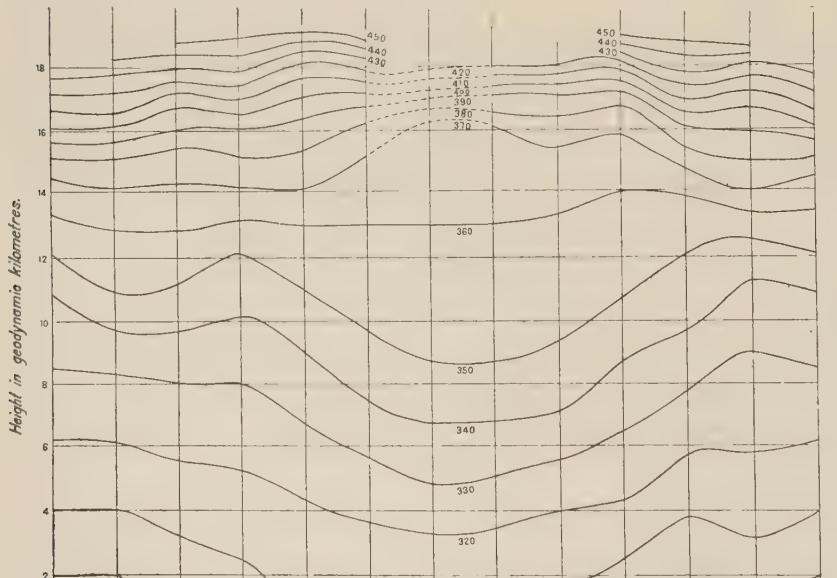

FIG. 2.—Annual variation of potential temperature with height at Agra.

2. Within the tropics during summer the isentropic lines have a downward slope towards the north practically throughout the troposphere, while between 30° N. and 50° N. they have an upward slope to about 12 gkm. Tropical storms and depressions occur mostly in the neighbourhood of this V-shaped trough in the isentropics and move from an easterly direction in the region where the isentropics fall towards the north and from a westerly direction in the region where they rise.

In connexion with Fig. 1, it may be interesting to point out the close analogy which the distribution of potential temperature in Fig. 1 bears to the seasonal variation of its distribution over Agra (Fig. 2). The influence of the high value of entropy below 12 gkm. in raising the tropopause and increasing the inversion above it is clear in both cases.

K. R. RAMANATHAN.

Meteorological Office,
Poona, 5,
India, Aug. 2.

Effect of Atmospheric Pressure on the Frequency of a Tuning-fork.

DUE to the necessity of obtaining accurate values of high frequencies in radio communication, the establishment of a frequency standard of high order of accuracy has already been undertaken in various countries. The usual method is a single frequency standard system. It naturally requires an ideal

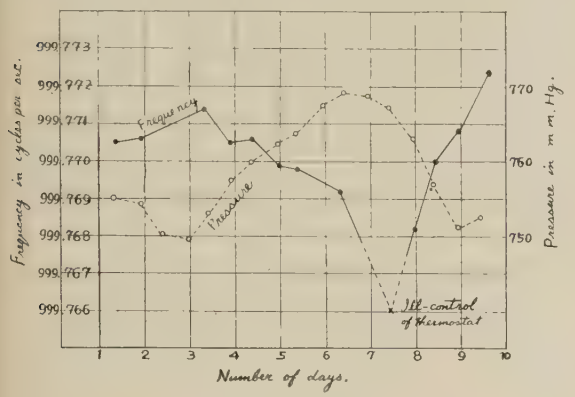

FIG. 1.

vibrator of extremely high order in constancy. A valve-maintained tuning-fork, according to Eccles, has been widely employed.

For the same purpose, one of the valve-maintained tuning-forks of 1 kc./s., made of elinvar steel, has

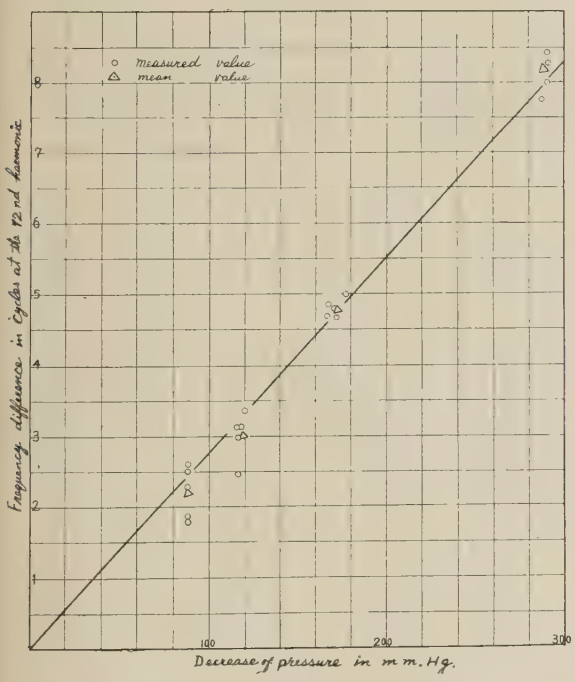

FIG. 2.

been maintained at this Laboratory since 1928. All the possible sources of frequency variation have been examined and reduced as much as possible; namely, effects due to temperature, electrical sources, output load, humidity, and surrounding conditions. The results of frequency measurement which are accurate to within one part in a million have shown that the effect of atmospheric pressure should not be neglected.

One example is shown in Fig. 1, which represents the result obtained from observations carried out over a period of ten days, and it clearly shows the effect. It also shows that the fork does appreciable acoustic work when it is in vibration, and the air-loading varies the damping of the fork, which in turn changes its frequency, as indicated by A. B. Wood (*Jour. Scientific Instruments*, vol. 1, No. 11, p. 330; 1924). Wood, referring to forks of low frequency, states in his paper that the direct effect of damping on frequency is quite negligible compared with that due to other causes, but when other factors are sufficiently reduced the effect will be predominant.

With the view of verifying this fact, the fork was tested in the pressure chamber, and the results are shown in Fig. 2, which gives the relation of the frequency difference in cycles at the seventy-second harmonic to the decrease of pressure in millimetres of mercury. It indicates that the relation is linear within the accuracy concerned, and the sense of the variation justifies my theoretical reasoning. The pressure-coefficient of frequency of the fork in air was $-(2{\cdot}7_7 \pm 0{\cdot}05) \times 10^{-7}$ cycle per mm. of mercury change of pressure.

Y. NAMBA.
Electrotechnical Laboratory,
Ministry of Communications,
Tokyo, Japan, July 15.

Raman Effect from Powdered Crystals.

RECENTLY it was desired to obtain by Raman observations, information as to the effect of solution on the infra-red vibration-frequencies of groups in crystals. But so far, observations on solids have had to be restricted to such substances as can be obtained in large clear crystals.

An attempt was made to obviate this difficulty by immersing crystals in a liquid of the same refractive index. This was found to be made difficult by the optical anisotropy of the crystals and by the differing dispersions of the solid and of the surrounding liquid.

It was then thought worth while to try if repeated reflection from the crystal surfaces would give rise to Raman radiations. Light from a quartz mercury vapour lamp was sent into some coarsely-powdered potassium nitrate crystals contained in a small (100 c.c.) flask, and the light which issued from the side of the flask was observed with a Hilger *C.D.* glass spectrograph (suitably screened from the source). Thus the spectrum was obtained of the light which had been reflected many times from the surfaces of the crystals (and doubtless transmitted through crystals as well).

In the spectrum, the lines of mercury were very strong, but two new lines appeared having frequencies 23651 cm.$^{-1}$ and 21885 cm.$^{-1}$. These two new lines were extremely sharp. Treated as shifts, they correspond to shifts to the red of 1053 cm.$^{-1}$ and 1052 cm.$^{-1}$ from exciting frequencies 24704 and 22937 respectively.

In order to confirm that these new lines were really due to the potassium nitrate crystals, another exposure was made with conditions unaltered except that crystals of potassium bromide were now used, of a similar degree of coarseness. The lines were absent, as would be expected, since potassium bromide will not have Raman radiations in this region at all.

It is concluded that the shift 1052 cm.$^{-1}$ is due to the inactive fundamental of the NO_3 group, especially as the inactive fundamentals appear with great intensity in the Raman effect. The wave-length corresponding to the shift is 9·52 μ, and this is of the right order.

Thus it is clear that Raman spectra can be obtained

using powdered crystals, so that a large field of observation is opened up.

I propose to explore this field, determining first the best arrangement of apparatus, and then making observations on different salts in powder form. It is hoped that even opaque powders can be dealt with in this way. A. C. MENZIES.

University College,
Leicester, Sept. 23.

Fossil Laterite from Southern Queensland.

IN view of the diverse opinions held by pedologists as to the occurrence of laterites in extra-tropical regions, I wish to direct attention to what I regard as a true laterite in Southern Queensland.

Some authorities, of whom one need mention only Glinka, appear to hold that true laterites are confined to tropical regions of heavy rainfall and that laterites reported from extra-tropical regions are either (i.) not true laterites, (ii.) are developed where climatic conditions closely resembling those of the humid tropics exist, or (iii.) are fossil soils which were originally developed under tropical conditions. In the case under discussion the laterite appears to be true to type, but the climatic conditions are far removed from those considered by Glinka as necessary for the formation of laterites, so that the most reasonable explanation would seem to be to consider the soil a fossil laterite.

At many places about Brisbane there occur deep red soils to which the somewhat comprehensive adjective 'lateritic' may be safely applied, but the occurrence to which I wish to direct attention is at Scarborough, a seaside resort twenty miles north of Brisbane and in Lat. 27° 15′ S. The average annual rainfall of the locality is 47·5 inches, of which 32·5 inches falls in the summer between Nov. 1 and April 30. The highest monthly average is February with 6·64 inches, and the lowest August with 1·57 inches. No temperature records are available for the spot, but those of Brisbane should be close enough to give a general indication of conditions at Scarborough. The Brisbane figures are: Mean annual shade temperature, 68·9°. The highest monthly mean is 77·0° (January), and the lowest, 58·5° (July). The natural vegetation at present growing on the laterite is open savannah forest characterised by eucalypts with a ground covering of grasses and herbaceous plants.

A typical section of the soil at Scarborough gave the following profile:

Red-brown soil, with definite crumb structure	2 ft. 6 in.
Brick-red soil with crumb structure	3 ft. 6 in.
Red soil thickly studded with rounded black ferruginous concretions ⅛ in. to ½ in. in diameter	2 ft. 3 in.
Red and white mottled horizon with larger less regular ferruginous concretions	3 ft. 6 in.
Red-brown and purple reticulate and cellular ironstone in parts mottled with white clay	3 ft. +

The uppermost horizon is the least lateritic. May this indicate a tendency of the soil towards a condition more nearly in equilibrium with the present climatic conditions?

A more detailed account of this occurrence is at present in preparation as a contribution to the *Proceedings* of the Royal Society of Queensland.

W. H. BRYAN.

The University of Queensland,
Department of Geology,
Brisbane, July 25.

A Crystalline Tripeptid from Living Cells.

THE sulphur-containing tripeptid glutathione was originally obtained by Hopkins (*Biochem. Jour.*, **15**, 286; 1921) as a slightly impure non-crystalline powder. Hopkins has now succeeded in obtaining the substance in a pure crystalline form (NATURE, Sept. 21, p. 445). On repeating with this pure glutathione the experiments of Hopkins and Dixon (*Jour. Biol. Chem.*, **54**, 527; 1922) and of Hopkins (*Biochem. Jour.*, **19**, 787; 1925) on the oxidation of tissue proteins, we have found differences in behaviour which must have an important bearing on the glutathione problem.

We find that pure glutathione is unable to catalyse the oxidation of the proteins of thermostable muscle preparations, although we have confirmed that impure glutathione rapidly does so. On the addition of pure oxidised glutathione to a muscle preparation, no oxygen uptake is produced. The crystalline reduced form, like the earlier preparations, is autoxidisable owing to the presence of minute traces of catalytic metals; but so far from catalysing the oxidation of the proteins its autoxidation is itself inhibited by the addition of the muscle preparation. On addition of muscle powder to a solution of reduced glutathione the oxygen uptake ceases, and on filtering off the muscle a solution of 'stabilised' glutathione is obtained which shows practically no oxygen uptake. This effect is not due to removal of catalytic metals by the muscle, for the stabilised glutathione solution is not rendered autoxidisable by the addition of iron or copper salts or hæmatin, even in considerable amount. It is, however, re-activated by the addition of a small amount of impure glutathione.

A solution of crystalline reduced glutathione is also rendered stable to oxygen by treatment with kaolin. This is, however, simply due to the removal of catalytic metals by adsorption on the kaolin, and in this case the filtrate is re-activated by the addition of traces of ferrous salts, etc.

It is clear that, while the oxidation of glutathione depends on the presence of catalytic metals, these are not by themselves sufficient, and the simultaneous presence of some additional factor is essential. This factor, which appears to be present in considerable amounts in the impure glutathione but only in traces in the crystalline preparation, is removed from the solution by the thermostable muscle preparation, which thus stabilises the glutathione. We think it probable that the substance forms a catalytically active complex with the metals present, since the free metallic salts, and any complexes which they may form with glutathione, are inactive. The nature of the extra factor has not yet been definitely settled, and further work is in progress.

M. DIXON.
N. U. MELDRUM.

Biochemical Laboratory,
Cambridge.

Ionisation Potentials and Conductivities of Metals.

ON the hypothesis of the existence of 'free electrons' in metals, Drude, Lorentz, and recently Sommerfeld have explained the Wiedemann and Franz law, namely, that the ratio of the thermal and electrical conductivity is the same for all metals, and is proportional to the absolute temperature. In a paper by Mukherjee and Ray, to appear shortly, the authors, in order to explain the conductivity of metals, have pictured the 'valency shells' of the neighbouring atoms as touching each other, and thus forming a large equipotential surface in the metal crystal. Electrons in this surface travel freely without

doing any work, and in this restricted sense they are termed 'free'.

Now if these 'free electrons' are really responsible for electrical and thermal conductivity, it is only natural to expect a relationship between the ionisation potential and electrical (or thermal) conductivity of any metal atom. The following table shows the relationship, where N represents the atomic number, K the electrical conductivity, and I the ionisation potential. The values of K are taken at 0° C.

Group.	Element.	Structure of Crystal.	$\frac{1}{KNI} \times 10^8$.
I.	Na	Body centred cube	7·8
	K	,,	8·0
	Rb	,,	8·1
	Cs	,,	8·5
II.	Zn	Hex. close packed	2·0
	Cd	,,	1·8
III.	Al	Face centred	3·3
	In	,,	3·0
	Tl	,,	3·5
IV.	Sn	Tetragonal cube	3·5
	Pb	Face centred	3·3
V.	As	Body centred	9·2
	Sb	,,	9·0
	Bi	(?)	18·0(?)
VI.	Cr	Body centred	1·6
	Mo	,,	1·4
VIII.	Fe	Body or face centred	4·7
	Ru	Hex. close packed	4·3
	Co	Face centred or hex. close packed	4·24
	Rh	Face centred	1·34(?)
	Ni	Face centred	2·74
	Pd	,,	2·70

The above table shows that in any group of elements, *if the metals possess the same crystal structure, the product of electrical conductivity and ionisation potential* ($K \times I$) *varies inversely as the atomic number* (N). Discrepancies occur in the cases of magnesium, calcium, strontium, rhodium, and bismuth. A fuller treatment of the subject will be published shortly.

B. B. RAY.
D. P. ROY CHAUDHURI.

University College of Science,
92 Upper Circular Road,
Calcutta, Aug. 22.

Dew: Does it Rise or Fall?

WHEN I was studying the subject of dew-ponds, I made many hundreds of experiments on dew, and these went to show that under suitable conditions there may be upward dew or downward dew. In his "Essay on Dew", 1814, republished in 1866, Wells stated that dew was formed from moisture already existing in the air and was deposited on the tops of good radiators. Blythe, however, said in 1836, in his edition of "Selborne", that "the true theory of dew is that it rises from the ground and does not fall, as is the common opinion".

This view was also demonstrated by Aitken, and in certain circumstances I found that it is true. On some nights an inverted tray was found to be bedewed only on the underside, and the undersides of stones were also moist with dew. This dew must have been formed from the moisture which had arisen from the soil with radiant heat after nightfall. But the fact remains that most of the dew is found on the upper-sides of radiating materials, and it seems to follow that it 'falls', although the distance through which it falls cannot be great. It is where there is the greatest radiation of heat that it is deposited, and this is as a rule on the uppermost sides of grass, stones, feathers, or cotton wool, etc.

It seems to stand to reason that the moisture already in the atmosphere near the soil will be the first to fall below dew-point, although this may be difficult of proof. My point in writing is to suggest that according to the conditions prevailing either theory is correct.

EDWARD A. MARTIN.

26 Oliver Grove,
S.E.25.

The Translator of Newton's "System of the World".

NEWTON'S book, the "System of the World", has laboured under two uncertainties, the first as to its authorship, the second as to the translator of it into English. The first uncertainty, raised by De Morgan in his "Budget of Paradoxes" (1872, p. 83), has been removed, but the second still prevails, according to G. J. Gray's "Bibliography of the Works of Sir Isaac Newton", second edition, 1907, p. 20. I wish to prove that it was translated by Andrew Motte, the translator of the "Principia". This follows conclusively from a comparison of the translation of a practically identical passage of about 850 words in the "Principia" and in the "System of the World". No two independent translators could use language so very nearly identical. Consider, in particular, a critical phrase in that passage ("Principia", Bk. 3, Prop. 41, Example; "System of the World", Paragraph 67): "Nam quod dicitur Fixas ab Aegyptiis comatas nonnunquam visas fuisse". The translation of "comatas" caused trouble and was rendered in both books by the use of three words, "coma or capillitium", the whole phrase being translated, "For as to what is alleged that the fixed stars have been sometimes seen by the Egyptians, environed with a coma or capillitium". Such singular coincidence in a free translation makes it certain that both books are rendered into English by the same translator.

FLORIAN CAJORI.

University of California.

Structure of Trebly Ionised Chlorine.

WHILE investigating the nature of spectra given by halogens in their different states of ionisation, I came across certain lines of chlorine which I found as arising from its trebly ionised state, due to the transition $M_2(N_1 - N_2)$. The fundamental transition has been investigated by Bowen and the differences are taken from his paper (*Phy. Rev.*, **31**, 36; 1928). The differences are ${}^3P_0 - {}^3P_1 = 362$; ${}^3P_0 - {}^3P_2 = 1434$. The chief lines of the group $M_2(N_1 - N_2)$ have been thus located: ${}^3P_2{}^3D_3$ at $\nu = 34918$; ${}^3P_2{}^3P_2$ at $\nu = 37227$; and ${}^3P_2{}^3S_1$ at $\nu = 38554$. The singlet system and the intercombinations have also been obtained: thus ${}^1P_1{}^1P_1$ at $\nu = 38088$. The difference ${}^3P_0{}^1P_1 = 1643$.

SURESH CHANDRA DEB.

Physical Laboratory,
University of Allahabad,
July 25.

Conocephalum conicum.

I HAVE just come across a rather fine quantity of this interesting hepatic in the fruiting condition. The plant is well established in that particular place, and I shall be delighted to forward the material to anyone who is engaged in the working out of the cytology, etc., of the fructifications.

A. G. LOWNDES.

Marlborough College,
Wilts.

The Species Problem in the Light of Genetics.[1]

By J. B. S. HALDANE.

DARWIN held that the differences between species were due to the accumulation of such smaller differences as distinguish varieties within a species. Since the rediscovery of Mendel's papers, a vast amount of work has been done on the genetical basis of intra-specific varieties, and a smaller, but still considerable amount, on the genetics of specific differences.

Intra-specific differences, so far as they are hereditary, can be classified as due to one of the following causes :

1. Extra-nuclear 'factors', or plasmons. These are inherited entirely or almost entirely through the mother. They cause many of the differences in chloroplasts between different plant varieties, the plastids being handed on maternally as more or less independent units. They may also interact with nuclear factors to alter such characters as the development of the anthers. They are not certainly known in animals.

2. Single intra-nuclear factors, or genes. An enormous number of varietal differences, in both wild and domesticated organisms, have been shown to be due to one, or a small number of genes.

3. Multiple genes. Quantitative differences are often due to the action of a number of genes. In some cases an apparently continuous varying character can be shown by careful analysis of individuals to be determined in this way. Moreover, Fisher has shown that the correlations found for human stature between relatives by Pearson and his pupils are in quantitative agreement with expectation on the hypothesis that they are due to multiple genes.

4. Differences in the arrangement of genes within a chromosome. Sturtevant has shown that different geographical races of *Drosophila melanogaster* differ in the order of the genes in a chromosome, as determined by linkage experiments. A section of a chromosome of one race appears to have been reversed in the other. Similar results have been produced by Muller with X-rays.

5. Differences in chromosome attachment. A chromosome of one variety may be represented by two smaller bodies in another, as in *Zea Mays*, or a fragment may be attached to different larger chromosomes in different varieties, as in *Drosophila melanogaster*.

6. Unbalanced differences in the amount of chromatin. One or more chromosomes, or portions of them, may be represented once, thrice, or four or more times in a variety, as compared with twice in the type. This is not only the genetical basis of sex in most organisms, and of intersexuality and other abnormalities in some, but also occurs in varieties of other types. For example, some fatuoid oats, and most cultivated sweet cherries, have one or two chromosomes in addition to the set characteristic of the species. In this condition some genes are represented three or four times, the majority twice. This generally produces a greater effect on the visible character than results from a trebling or quadrupling of the haploid number of all the genes at once.

7. Polyploidy. The number of chromosomes is here two, three or more times as great in one variety as in the other. This generally results in an increase of size, but often the visible effect is very small indeed, far less than that of many single factors or of an unbalanced difference in chromosome number. But it invariably results in a certain degree of physiological isolation. Not only is there often difficulty in crossing a diploid and a tetraploid, but also, if the union is fertile, the hybrid is generally a triploid, and therefore much more sterile than either parent owing to irregularities in meiosis.

Differences of all these types have arisen in animal and plant races under observation, and all but the first have been produced experimentally. So far as I know, there is no clear evidence that any intra-specific hereditary variations are due to causes other than these, though it is possible that the list is not yet complete, and some of the cases ascribed to multiple genes demand much further study.

The assertion is still occasionally made that characters inherited in a Mendelian manner are pathological. This may, I take it, mean one of two things. The character may be supposed to be disadvantageous to its bearer. Much of the variation in shell pattern of wild *Cepea nemoralis* is due to two factors. Diver has shown that the four races produced by the interaction of these factors have been in existence in England since Neolithic times, and although it is conceivable that one race may have some slight advantage in a particular environmental niche, there can be no such advantage in the country as a whole, or selection would have eliminated certain of the types. Naturally, however, most variations from the normal are disadvantageous in a normal environment, and are therefore eliminated by natural selection. Many mutants are definitely shorter lived or less fertile than the type. But Pearl and his pupils have shown that in artificial conditions some of the mutant types of *Drosophila melanogaster* are more fertile than the type, others longer lived. Such mutants cannot be called pathological.

Secondly, it may be meant that a Mendelian character is pathological because it is due to injury. Mutants are produced in large quantities by X-rays, and it may be that much of normal mutation is due to the β- and γ-rays from potassium, other radioactive substances, and cosmic radiations. I can see no reason why such mutation should be regarded as more pathological than photosynthesis or sunburn. It is probably a prerequisite of evolution, and its effects are not necessarily harmful either to the individual or the species, though often so to the individual.

[1] Paper read to the Society for Experimental Biology on June 15.

Inter-specific differences are largely due to the same causes as intra-specific. In general, they can only be analysed genetically where the species can be crossed. But this is not always the case. For example, the order of the genes in the chromosomes of different species of *Drosophila* can be shown to be nearly, but not quite, the same. The linkage values of homologous genes are somewhat different in the mouse and rat. Since the yellow *Primula acaulis* and related species differ from the purple *P. Juliae* by the loss of a gene needed for anthocyanin formation, it is very plausible that other yellow Primulas also lack this gene.

Differences in chromosome number and arrangement can, of course, also be observed apart from crossing. A few examples of inter-specific differences will now be given under the same classification as that adopted for intra-specific.

1. In a number of plant species crosses, one of the F_1 hybrids is vigorous, while the reciprocal has defective plastids, and is yellow or variegated. Renner regards this as due to the inviability of the maternally inherited plastids in the presence of the hybrid nucleus. A very clear case of a plasmon causing sexual abnormality after species crossing occurs in *Geranium* (unpublished work of the late Mr. Newton). There are probably analogous cases in animals; indeed, wherever adult reciprocal hybrids of the homogametic sex differ, extra-nuclear inheritance may be suspected.

2. Mendelian segregation for some characters in F_2 is very common. Apart from cases where varietal characters of one species still behave in a Mendelian manner after the crossing, some of the actual specific characters are so inherited. Sometimes, however, the ratios in F_2 diverge markedly from expectation.

In plants the genes by which species differ often cause striking differences. Thus Chittenden showed that the purple *Primula Juliae* had no gene for plastid pigments, the primrose none for anthocyanin. Hence white flowers appeared in F_2. On the other hand, the colour genes distinguishing crossable rodent species cause rather smaller changes, and are multiply allelomorphic with genes causing the sharp differences distinguishing domestic varieties. Thus *Cavia porcellus* has a gene for yellow-bellied agouti, *C. rufescens* for agouti-bellied agouti, both allelomorphic with the gene found in the well-known black variety.

3. When species are crossed the F_1 is generally uniform, the F_2 variable, often differing among themselves more than do the parent species. This fact is, of course, the principal reason why hybridisation is employed in horticulture to obtain striking new forms The phenomena can be exactly paralleled in varietal crosses, and are probably due to multiple gene differences.

4. The order of the genes is slightly different in *Drosophila melanogaster* and *D. simulans*, and probably in other *Drosophila* species which cannot be crossed.

5. There is strong cytological evidence for this when the chromosomes of different species are compared, and fairly good genetical evidence both in *Drosophila* and mammals. Thus the gene the loss of which converts a grey mammal into a yellow is sex-linked in cats but not so in rodents, suggesting that a corresponding gene is carried by the *X*-chromosome in the cat, by another chromosome in rodents.

6. Unbalanced differences of this type between species probably occur in *Viola* and some other genera. They are not, however, quite so well authenticated as types 5 and 7.

7. This type of difference is very common in plants, and extremely rare in animals. For example, in *Rosa*, species with 14, 28, 42, and 56 chromosomes are known, besides species with intermediate numbers, which are probably hybrids.

It is obviously impossible to state that all inter-specific differences can be explained on these lines. It is, however, doubtful whether any differences are known which cannot be so explained. In view of the very great morphological and physiological differences produced by single genes, there is no reason to doubt their capacity for causing inter-specific differences of these kinds, which are often less striking than varietal differences. The stumbling-block in the past has been the failure to find, between varieties, the physiological barrier which often prevents the effective crossing of species. This failure was regarded as a serious but not fatal objection to Darwinism by such men as Huxley and Romanes. It has now been completely overcome. Let us consider, for example, *Primula sinensis* and its tetraploid variety *gigas*. Every plant of these forms in England is descended from the same few seeds brought over from China in 1819–26. The giant tetraploid form has originated on several occasions in cultivation since 1900. Tetraploid pollen on the diploid stigma has never produced a single seed. The reciprocal cross, though very extensively made, has produced about a dozen hybrids. These hybrids are often triploids, and hence have irregular reduction divisions, and are far less fertile than either parent. We have thus a complete analogy to the case of true species, and indeed some geneticists regard such tetraploids as new species. Such tetraploidy can sometimes be produced by injury of the diploid plant. This produces a tetraploid branch, and if this branch is self-fertilised, the seedlings are tetraploids. Incidentally, this is the only case known to me in which a *somatically* acquired character is transmitted by sexual reproduction.

Phenomena similar to those found in the F_2 of species crosses may be produced by the action of small numbers of genes. Thus Gonsalez found the following expectations of life in days for *Drosophila melanogaster* females. The characters are recessives and combinations of recessives two or three at a time.

Wild	40·6
Purple (eye)	21·8
Arc (wing)	28·2
Speck (axilla)	38·8
Purple, arc	32·0
Purple, speck	23·0
Arc, speck	34·7
Purple, arc, speck	40·7

Clearly this last combination represents a physiological balance as good (under the artificial culture conditions) as the normal. All other combinations are below the viabilities of the triple dominant or the triple recessive. It is well known that when species are crossed, the F_1 generation, though itself often vigorous, produces gametes and zygotes less vigorous than those of the parental types. In some cases I conceive that related species are simply those genotypes, out of a large possible number, which possess the highest viability.

I contend, then, that all specific differences so far analysed may be due to the cumulative action of known types of varietal difference. Whether they actually are so is another question, but on the principle that *entia non sunt multiplicanda praeter necessitatem*, we are justified in assuming, as a provisional working hypothesis, that they are. The question as to how species arise in Nature is a much more complicated one. Natural selection undoubtedly occurs ; on the other hand, the environment may influence the rate of mutation, and it is probable that mere chance plays a certain part in establishing new types. Many other causes of evolution have of course been postulated. Which of these processes is the more important is a matter which can only be decided by observation of Nature, and not by experiment alone.

Aspects of Psychology in Education.[1]

By Dr. C. W. KIMMINS.

ONE of the most significant of recent movements in education is the change of attitude towards the mental development of the very young child. Until comparatively recently, the physical condition of the child up to the age of six years was the only matter that appeared to need serious attention. Educationists and psychologists now, however, at long last, fully realise that the period from two to six years of age is far and away the most important of the child's life. In other words, there must be a really sound foundation if a satisfactory superstructure is to result in the child's development. The mental as well as the physical welfare of the young child must receive adequate attention. The reliable evidence we possess that many of the cases of serious mental trouble in later life may be traced to unwise treatment in early childhood is a case in point. During this period of active habit formation, when the necessary sublimation of nascent instinctive impulses is relatively an easy matter, the value of intelligent guidance is too obvious to need further mention.

As if to make up for the neglect of past years of the importance—the extraordinary importance—of a fuller knowledge of the beginnings of education and the dawn of intelligence of the young child, there has been of recent years a concentration of investigation on this period by distinguished experts, which has fully compensated for the lack of adequate research in earlier times. The manifest difficulty of discovering by direct observation how the very young child approaches and overcomes obstacles in the great adventure of becoming acquainted with the nature of his strange environment, has to a very considerable extent been aided by experiments with the more intelligent animals.

The great value of this type of investigation is that tasks of varying difficulty can be given to the animals, such as the improvement on repetition, the memory of success in an earlier experiment in attempting a more difficult task of the same nature and so on, can be carried out and conclusions reached. Obviously, it would be impossible to make a young child go through a long series of conditioned experiments, and thus acquire a knowledge which can be obtained so readily by experiments with animals. When isolated experiments of a like nature were carried out with young children, the similarities of response and the means adopted in reaching the desired end were very significant.

The remarkable difference which exists between the child's world and that of the adult presents very serious difficulties in the study of young children. This has, in the past, given rise to much serious misunderstanding as to the real attitude of the child to life. A fertile source of this difficulty is to expect a child to adopt the adult position before the appropriate time in his mental growth has been reached. Long after speech has been acquired, the meaning of a simple expression, in exactly the same words, may convey to the mind of the child something entirely different from the meaning which it conveys to the mind of the adult. Much work in this connexion has been carried on in recent years with considerable success. Many attempts have been made to summarise the main points of difference between the two worlds.

The astounding progress made in the past twenty-five years in our knowledge of the pre-school child must be referred to not only for its intrinsic importance, but also because original work at this stage of development has had such a beneficent effect in popularising education, especially in its social implications. In the school we have a sufficiently large number of children for observation, and possibly for experiment. We can generalise and compare group with group. But the pre-school child is a thing apart, and the nursery is the nearest approach to the class-room. On the physical side the pre-school child is within reach of experts. The local doctor, the mother and the nurse, or other attendant, possess, or should possess, a fair knowledge of childish ailments. On the mental side, however, there is a lamentable deficiency of anything in the nature of expert guidance, the general opinion being that this side of the child's development can safely be neglected until the child goes to school.

We have already pointed out the folly of such

[1] From the presidential address to Section L (Educational Science) of the British Association, entitled "Modern Movements in Education", delivered at Cape Town on July 25.

a generalisation. The pre-school period is singularly rich in the opportunity it offers for wise, expert assistance. Parents, however, are now beginning to realise how remarkably clever their young children are, and what native ability they possess of overcoming obstacles which present themselves.

The period of about three to six years of age is characterised by abnormal imaginative power. This is the stage at which the invisible friend or other childish fantasy makes its appearance. At three years of age the child fully recognises himself as a separate entity in the environment. During this imaginative period the child delights in making up stories, and many of those which have been recorded exhibit a very remarkable ability in this direction.

A careful study of childish *naïveté* affords ample evidence of the very considerable ability of the pre-school child. It reveals interesting glimpses of the mental make-up, the quaint judgments, the curious application of words the true meanings of which are imperfectly understood, and the child's sense of justice. In many ways such a study is far more interesting than that of the school child, whose submission to authority has somewhat diminished his originality and standardised his outlook on life.

This greatly increased interest in the mental welfare of the young child has naturally resulted in a renewed demand for a better provision of institutions, such as nursery schools and kindergartens, concerned with the care and education of pre-school children with a range of age of two to six years.

Apart from the new attitude to the pre-school child, the most important movement in education since 1905, the date of the last meeting of the British Association in South Africa, is the coming of the intelligence test and its incorporation as an essential element in the general scheme of education. Probably more research has been carried out in recent years in connexion with tests for intelligence than in any other department of educational activity. Even if only rough approximations could be secured in the measurement of native ability, the advantage of such a discovery would naturally make a very strong appeal to the mind of progressive educationists. The researches of Binet and Simon clearly pointed the way to the attainment of a means of estimating innate intelligence. As a consequence, the Binet-Simon scale has been the starting-point for an enormous amount of original research on a subject which was destined to yield a rich harvest to the investigator if a really satisfactory working method of testing native ability could be obtained.

Various revisions of the scale have been adopted in different countries and improvements have been, and are still being, made. We are as yet very far from having reached the ideal form of intelligence test, but sufficient has already been done to show by actual experience, in a variety of ways, the remarkable value of individual and group tests.

Intelligence tests in connexion with school organisation are found to be of great value as an additional factor in promoting children from class to class. It is evident that, as there is such a wide range of native ability in boys and girls of the same age, anything in the nature of a rigid chronological basis in school classification must be profoundly unsatisfactory. Not only that; imperfect classification may, and frequently does, inflict very serious injury on the misplaced child. The supernormal boy or girl placed in classes with children of the same age, but of markedly inferior ability, runs a great risk of becoming an exceptionally lazy person, though he or she may without the slightest difficulty be at the top of the form or class, and be the recipient of wholly unmerited praise.

In the *Begabten Schulen* in Germany, where, in the final selection for admission, the results are based almost entirely on the intelligence quotients of the candidates, one cannot fail to be greatly impressed by the ease with which these children, without any undue pressure, can successfully cover as much ground in one year as normal children would require at least two years to accomplish. In the days to come we shall give far more attention to the super-normal child than we do at present. One of the many virtues of the Dalton plan, which is having a profound effect on English and American education, is that it makes ample provision for the super-normal child.

A very promising direction in which intelligence tests may render invaluable assistance is to be found in vocational guidance. In view of the enormous—and ever increasing—expenditure on education, it is remarkable that until recently so little attention has been given to the successful marketing of the produce of our schools. The 'after-care' agencies—frequently voluntary organisations—have done excellent service in various districts in looking after the interests of children seeking employment on leaving school. Their activities have, however, been largely of a social order, involving securing information as to the reputation of firms employing children and the conditions of labour, the possibilities of advancement, and so on. The members of such welfare committees often keep in touch with the employees and advise the children when difficulties, which by friendly co-operation can be adjusted, occur in connexion with their employment. The frequent changes of employment, which have such a demoralising effect on children, may be diminished to a marked degree in districts which are fortunate in possessing a really efficient after-care committee.

The judgment of the school as to the type of employment for which a particular child is suited is also of considerable value. Without underestimating in any way the importance of the beneficent effect resulting from the various after-care agencies on the future welfare of the children, it is evident that if by intelligence and specially devised vocational tests, a clear statement could be made, on a scientific basis, as to the kind of occupation, or group of occupations, in which a child, on leaving school, may find the fullest expression for any native ability which he is found to possess, it would be of the greatest possible service.

Indeed, it is not unreasonable to hope that, in

days to come, every boy (and girl) on leaving school will have reliable information as to the kind of work in which he can most effectively use the ability he possesses, with pleasure and satisfaction to himself and to his employer. In this case the hopeless situation involved in 'the square peg in the round hole' will tend to disappear.

In dealing with modern movements in education it is necessary to make a passing reference to the great possibilities offered by the cinema and the wireless. Experiments in various directions have been, and are still being, made to explore methods which may result in one, or, still better, both, playing a useful part in modern schemes of education. The natural objections raised to purely visual or purely auditory instruments in educational procedure may be met within the near future by the speaking film or the synchronisation of the normal educational film with the loud-speaker, thus eliminating the obvious necessity of the film lecturer.

The comparative failure of the so-called educational film in picture houses is largely due to the attempt to satisfy the student, and at the same time to secure the interest of the larger *clientèle* of the picture palace, the popular audience, which is rendered necessary for financial reasons. During the sitting of the Cinema Commission, an investigation was made of the popularity of different types of film among the school children frequenting picture palaces. In practically every case the educational film was at the bottom of the list. It did not appear possible to meet the claims of the two classes of patrons, although praiseworthy attempts were made to produce exceptionally good results from the point of view of successful production. For educational purposes it is evident that the element of popular appeal must be subordinate to the instructional objective.

On the other hand, a valuable research has been carried out, aided by generous subventions by the Carnegie Trust and the National Council of Public Morals, to test the efficacy of the moving picture (film) as compared with the static picture (lantern slide) for teaching purposes. Prof. Spearman accepted the chairmanship of the committee appointed, and his psychological laboratory at University College, London, was fitted up with cinema appliances for the conduct of the investigation. Groups of children from neighbouring schools were instructed in different subjects by means of the lantern and the film respectively. The result was that there appeared to be an advantage of about 20 per cent for the moving picture both for immediate and delayed memory tests.

Many schools have recently experimented in using broadcast material as part of the general scheme of instruction with considerable success, any initial difficulties having been successfully overcome. It is probable that, in the days to come, the employment of the means of instruction offered by the cinema and broadcasting, either separately or together, will exercise increasingly useful functions in educational processes.

The Gorgas Memorial Laboratory of Tropical Disease.

IN fitting tribute to the memory of General Gorgas, 'The Redeemer of the Tropics', the Congress of the United States of America, at its session which closed on May 29 last year, authorised a permanent annual appropriation out of the United States Treasury of 50,000 dollars, as the contribution of the United States towards the maintenance and operation of the Gorgas Memorial Laboratory on the Isthmus of Panama.

On July 4, 1920, there died an American citizen, William Crawford Gorgas, who, from an obscure doctor in the United States Army Medical Corps, rose to become the greatest tropical sanitarian of history. He served as chief sanitary officer of Cuba from 1898 until 1902; as chief sanitary officer of the Panama Canal Zone from 1904 until 1907; as member of the Isthmian Canal Commission from 1907 until 1914, when the Canal was completed, and as Surgeon-General of the United States Army in the World War, from 1914 to his retirement, at sixty-four years of age, on Oct. 3, 1918. To him was given the vision and practical ability to make possible the conquest of disease in the tropics. He eliminated yellow fever from Havana, pursuing his plans in the face of great opposition, ridicule, and indifference. His successful campaigns in both Cuba and Panama for the suppression of mosquitoes greatly reduced the ravages of yellow fever and malaria, and made possible the conversion of a pestilential region into a safe cross-roads for the ships of the world.

The Gorgas Memorial Institute of Tropical and Preventive Medicine (Inc.) was created after the death of Gorgas, by his assistants and co-workers in the War, eminent physicians, surgeons, and sanitarians of international reputation. It forms no inanimate monument, but a living, working memorial to perpetuate the man's name by carrying on his ideas and ideals.

The key-note of the 'Gorgas idea' is that health is the foundation of our social and economic structure. The fundamental purpose of the Gorgas Memorial Institute is to conduct research into all preventable diseases, and to train men and women to assist in this prevention. Two main lines of approach are contemplated for the accomplishment of this purpose:

(*a*) A national educational campaign, through such channels as public press, radio and cinema, featuring the contributions of medicine to human progress, and the share and responsibility of the public in these contributions.

(*b*) The intensive study, in the tropics, of the causes and prevention of disease.

The first half of this programme has already been well organised and shown splendid results. The second half is now made possible under the terms of the Act and by means of funds thereby

authorised, and with the co-operation and aid of the Latin-American countries invited and authorised by the Act. The work of the Gorgas Memorial Institute has thus far been maintained wholly by funds raised through popular contributions.

Even with the assured prospect of funds, however, the purposes of the Institute remain purely humanitarian and scientific. It operates without profit; no part of the endowment fund is to be spent for buildings or equipment, nor any investment to be made in elaborate offices. The Republic of Panama has given a site and guaranteed initial buildings and equipment for tropical research laboratories, in recognition of Gorgas's great work in Panama, and is conducting a campaign to raise its quota for the endowment fund. Through economical administration the overhead expenses are kept extremely low. Those invited to serve as founder members are asked to subscribe 100 dollars to the endowment fund.

Governing boards are formed on the basis of 100 members to 1,000,000 population. Seventy-five per cent of the personnel of each committee will consist of medical men, and twenty-five per cent of influential laymen and women. The permanent activities of the organisation will be supervised by these governing boards sitting in their respective States.

The need and value of the proposed tropical research work are enormous. We have only to remember the conquests of yellow fever, malaria, and bubonic plague to realise the incalculable results which may come from the discovery of the method of transmission of a disease. On the single finding, by the Walter Reed Board in Cuba, that the *Stegomyia* mosquito is the transmitting agency of yellow fever, were based the great results in quarantine and mosquito work achieved in Cuba and Panama by the late General Gorgas, and the banishment from both these regions of this malignant, age-old plague. So, too, bubonic plague was brought under preventive control through the discovery that it was transmitted by the rat flea.

The malignant tropical maladies calling for further intensive laboratory research and study as to cause, transmission, control and prevention, are many. They include, among the better-known forms, malaria, yellow fever, leprosy, bubonic plague, sleeping sickness, amœbic dysentery, hookworm disease, etc. These diseases, it is true, are indigenous to the tropics, yet some of the most fatal—as leprosy and bubonic plague—may thrive with equal virulence and destructive power in the temperate regions. The almost universal scourge of malaria provides an ever-present problem of world-wide application. Finally, the discovery of sources and transmitting agencies of infection and of methods of control and prevention does not end the task. There remains the vital necessity of increased efficiency of these controlling and preventive measures.

While such research is the primary purpose of such an establishment as the Gorgas Memorial Laboratory, its nature and position give it another character, namely, that of an important centre to which will be invited students from all countries, so that it may receive the best of international thought and that its findings on the causes and prevention of tropical disease may be disseminated throughout the world. In view of the vastness of the field involved, it is obvious that there will be no overlapping of activities of any of the existing institutions by the establishment of the Gorgas Memorial Laboratory, since the work will be mutually supplemental.

Another useful purpose is served by the co-operation of the Latin-American countries, already referred to. To quote Dr. Franklin Martin (chairman of the Board of Directors of the Gorgas Memorial Institute), "Not only will the work serve a great humanitarian purpose in itself, along the lines of the conquest of the malignant maladies of the Tropics, but it offers an opportunity for an added bond of friendship between the United States and her sister nations on the Western Hemisphere". The United States are as much concerned by protective measures as the countries of central and southern America, since diseases indigenous to the tropics are easily transplanted into temperate zones owing to increased facilities in transport. In fact, all nations of the world are equally concerned, and all discoveries made in the Laboratory will manifestly be of world-wide benefit.

In his evidence before the House of Representatives, the Hon. Maurice H. Thatcher quoted from Dr. Wellcome's testimony as follows:

"In respect to Panama being the ideal location for the Gorgas Memorial Tropical Research Laboratory, I would say that Sir Patrick Manson . . . considered Panama to be one of the great tropical disease danger centres of the world. A number of years ago he pointed out that ships passing through the Panama Canal, and to and from the Isthmus and all parts of the world, would bring and carry all manner of diseases—bringing and leaving diseases while picking up and carrying others to various parts of the world. Sir Patrick regarded this as a very serious matter, and he expressed to me repeatedly his very strong views on this subject. I have heard him make similar statements at the London School of Tropical Medicine and elsewhere. Furthermore, I know that General Gorgas also held that same view."

The Isthmus of Panama is a peculiarly suitable site for the establishment of the Gorgas Memorial Laboratory for many reasons. Lying as it does in the heart of tropical America, it forms a convenient centre for the study of tropical disease. The Panama Canal, as one of the great focal points of international traffic, forms also a passage-way for the possible transmission of disease to and from every quarter, providing an admirable centre for preventive work. Finally, it is but fitting that the memorial honouring the name of the man who rid this region of pestilence and made the building of the Canal possible should stand here at the cross-roads of the world as a beacon light of safety and health, throwing its rays into all lands burdened with disease.

Obituary.

DR. T. J. I'A. BROMWICH, F.R.S.

THOMAS JOHN I'ANSON BROMWICH, who died at Northampton on Aug. 24, was the son of John I'anson Bromwich and was born at Wolverhampton on Feb. 8, 1875; he was educated at Bridgnorth, and later, when his parents had migrated to South Africa, at Durban. He went up to St. John's College, Cambridge, in 1892, and graduated as Senior Wrangler three years later.

Bromwich's 'year' was a remarkable one; in Part II. of the Tripos, Division I. of Class I. contained the record number of seven names, Bromwich's companions being Godfrey, Grace, Bertram Hopkinson, Maclaurin, Western, and Whittaker; in the same Tripos list occur the names of Alfred Young and of the present Master of Clare. The Smith's prizes in 1897 fell to Whittaker, Maclaurin, and Western; Bromwich received an honourable mention and was elected to a fellowship at St. John's later in the year.

In 1902, Bromwich was appointed to the chair of mathematics at Galway, but he resigned after a brief period in order to return to Cambridge in 1907 to take up a lectureship at St. John's. In Cambridge his industry in teaching, examining, and research soon became proverbial; but after ten years his health completely broke down, and teaching had to be discontinued, though at times he was well enough to make some of the most valuable of his investigations, and so recently as last June he was hoping to resume some teaching in the autumn.

Bromwich's earlier papers were mainly algebraic, on bilinear forms and allied topics, and these culminated in his 'Cambridge Tract' of 1906 on "Quadratic Forms and Their Classification". While at Galway he was compiling his book on "The Theory of Infinite Series"—a veritable encyclopædia—which appeared in 1908; for some years it was out of print and second-hand copies commanded fabulous prices until he was able to bring out a new and revised edition in 1926. The papers which he published while at Cambridge were mainly in the field of applied mathematics; in them is frequently apparent the influence of the work of Stokes, for whom he had a profound admiration. No small part of his energy at this period was spent in the service of the London Mathematical Society, of which he was secretary from 1911 until 1919.

The last phase of Bromwich's researches opened in 1916 with his memoir, now a classic, on "Normal Coordinates in Dynamical Systems". In this memoir he pointed out that Heaviside's calculus of symbolic operators could be put on a basis which was satisfactory to conventional pure mathematicians by treating Heaviside's operators as equivalent to contour integrals; he thereby began to open up a region which, so far as mathematicians were concerned, had been veiled in obscurity for some twenty years. Most of his subsequent papers may be regarded as developments of this memoir; they have already borne abundant fruit in the increasing attention which has been given in recent years to the developments of Heaviside's ideas. It may well be that by 'popularising Heaviside' he has contributed even more to the advancement of mathematical knowledge than by his book on infinite series.

Bromwich was elected a fellow of the Royal Society in 1906 and was awarded the Cambridge doctorate in 1909. He leaves a widow and one son.

G. N. W.

PROF. A. P. PAVLOV, professor of geology and one of the oldest members of the University of Moscow and a member of the Russian Academy of Sciences, died recently in Telz, Germany. Born in 1854, after completing his studies in the University of Moscow, where he took his degree in 1878, he was appointed a teacher in a secondary school in Tver. Two years later he was invited to become the Keeper of the Geological Department in the University of Moscow, and since 1886 he has been professor of geology and palæontology. In 1916 he was elected an ordinary member of the Russian Academy of Sciences. He attained widespread fame by his researches of the Mesozoic and Quaternary deposits of the Volga region and Central Russia, and by his classical works on the fauna of the Mesozoic period.

WE regret to announce the following deaths:

Mr. V. G. Bell, deputy commissioner of forests in the Federated Malay States, on Sept. 6, aged thirty-nine years.

Prof. Robert H. Bowen, assistant professor of zoology at Columbia University, who worked on cytoplasmic structures and the cytology of secretion, on Aug. 19, aged thirty-seven years.

Prof. Edward F. Buchner, since 1915 professor of education at the Johns Hopkins University and director of the college for teachers, and formerly professor of analytical psychology in New York University, on Aug. 23, aged sixty years.

Prof. E. E. Glynn, formerly professor of pathology in the University of Liverpool, and author of reports on enteritis, the bacteriology of pneumonia for the Medical Research Council, on Sept. 22, aged fifty-six years.

Prof. F. A. Gooch, emeritus professor of chemistry at Yale University, a member of the U.S. National Academy of Sciences and distinguished for his work in analytical methods, on Aug. 12, aged seventy-seven years.

Prof. J. S. Kingsley, emeritus professor of zoology of the University of Illinois, formerly editor of the *American Naturalist* and of the *Journal of Morphology*, aged seventy-five years.

Mr. E. H. Man, C.I.E., late deputy commissioner, Andaman Islands, author of "The Aboriginal Inhabitants of the Andaman Islands," on Sept. 28, aged eighty-three years.

Prof. R. Zsigmondy, professor of inorganic chemistry at the University of Göttingen, who was awarded the Nobel prize for chemistry in 1925, aged sixty-four years.

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Reviews.

Magic and Witchcraft.

(1) *The Magic Island.* By W. B. Seabrook. Pp. 320 + 35 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1929.) 12*s.* 6*d.* net.

(2) *Witchcraft in Old and New England.* By G. L. Kittredge. Pp. viii + 641. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1929.) 27*s.* net.

(1) HAITI, the Black Republic, was one of the most interesting and instructive of the many social experiments of the nineteenth century. In its early days it was favoured by the liberal and philanthropic movements which followed the ideals of the French Revolution. But the rapacity and brutality of the leaders of the Haitian revolt horrified the civilised world, while their vainglory and ostentation and their assumption of high-sounding but ridiculous titles gave rise to a derision which militated against recognition of the significance of the course of events in the island. If we now smile involuntarily at such titles as the Duke of Lemonade and the Prince of Marmalade, letters still extant from these two noblemen bear witness to their sincere desire to educate their people and a genuine interest in their advancement.

Haiti inevitably invites comparison with Liberia, the republic of the liberated American slaves. In Haiti the impulse to reach freedom and self-determination came from within. Yet in the ultimate analysis the results in both cases were not dissimilar, excepting for the greater infusion of European culture which constitutes the tragedy of Haiti. What is to be the outcome? Mr. Seabrook's sketch of Haitian society under the regime instituted by the United States after the occupation during the War is by no means reassuring. The Haitians do not appear to accord the settled law and order imposed *ab extra* an untempered enthusiasm. Be that as it may, the lessons taught by the two republics give pause to schemes for the overhasty advancement of backward races along lines which deviate too widely from their history and tradition.

Underneath the veneer of European culture—and it must be admitted that in many cases the veneer is highly polished—the Haitian is primitive. Outside the urban areas the peasant is at heart African. His religious beliefs have been affected by Roman Catholicism only in so far as they have been able to mould it to his own conceptions. In theory voodoo is not now permitted; in practice the rites are performed semi-surreptitiously. Mr. Seabrook traversed the country districts and lived among the negroes. He even became an initiate and was present at voodoo ceremonies. He describes, particularly and in detail, the ceremony at which the goat without a blemish used to be sacrificed. The human victim, a young girl, was present on this occasion, but with a goat as an obvious surrogate. Something like a transference of personality took place, the girl taking on the appearance of the animal in feature, which is remarkable if Mr. Seabrook has not allowed his imagination to cloud his powers of observation.

The whole account of the ceremony deserves careful study as an illustration in actual working of conceptions of incarnation, sacrifice, and the godhead with which the comparative study of primitive religion has made us familiar. The authenticity of Mr. Seabrook's narrative has been questioned. Dr. Elsie Clews Parsons, in a recently published study of Haitian spirit belief, regards the prominence given to the human sacrifices in voodoo as due to journalistic over-emphasis. Other observers have recorded little beyond magical practices and orgiastic dancing as the essentials of the belief. A recent writer, however, who visited Haiti after Mr. Seabrook, while recording evidence of magical practices only, confirms the truth of certain of his statements and, while suggesting a discount of his narrative, does actually go some way towards corroborating what he says.

While there is abundant evidence in Mr. Seabrook's account of voodoo of adapted Roman Catholic ritual, there is little to show any connexion with the more usual forms of European witchcraft. Several suggestions have been offered as to the origin of the name 'voodoo'; but there can surely

be no question as to its derivation from 'vaudois', the popular French term for organised witchcraft, generalised from its application to the heretical sect against whom the accusation of witchcraft was brought. But the 'devil worship' of the Haitian is a very different thing from the worship of the witches' sabbath. The latter, as usually described, is artificial and mechanical, the former definitely primitive in idea, if elaborate in form. The papaloi and mamaloi, however, are priest and priestess, magicians rather than witches. Nor does the belief in the 'obeah' man of negroes elsewhere in the West Indies and America point to the European witch. It is African in derivation.

(2) The distinction between magician and witch may appear one which is without a difference. Medicine man, witch, and even witch-doctor are sometimes used by writers on ethnographical subjects as if they were identical and interchangeable. White and black magic are only sometimes, but not always, differentiated in terms. Now the distinctive characteristic of the witch of the medieval trials was the compact with the devil. Recent writers, Miss Murray and Mr. Lowe Thompson in particular, regard the witch as a medicine man disestablished in the course of evolution. With the introduction of Christianity the priest has become the devil worshipper. In part this is historical fact. That we know. But how far is there continuity between the palæolithic horned leader of the dance and his presumed successors, and the historical witch? How far did a secret organised worship of the creative forces of Nature survive into medieval times as Miss Murray holds? The problem is how best to get at the facts.

Dr. Summers, accepting the validity of the dogma of the Church, engages in a heresy hunt through the evidence of the trials and other records. Miss Murray is also concerned with the legal evidence; she interprets it in the light of anthropological theory. Dr. Kittredge, in his "Witchcraft in Old and New England", attacks the problem differently. He too, necessarily, is largely concerned with legal and historical evidence, but he takes it not as evidence of what happened, but as evidence of what it was believed had happened. His is the method of the folklorist. For here in the facts of the case are the beliefs of the *folk*. Dr. Kittredge holds that the essential feature of witchcraft is then *maleficium*. Any untoward happening, whether preceded or not by a threat, is explained as the work, effected by magical means, of an individual who wishes ill to the victim. The witchcraft belief is an example of the universal primitive belief in magic surviving among the simpler members of a civilised society.

This method of attack has the advantage that it brings the whole body of the belief under one category. Medicine man and witch alike are nothing more than forms of expression of the primitive belief in magic. But the elaborate structure of medieval witchcraft then vanishes into thin air. It is, in Dr. Kittredge's view, the product of the theories of theologians and jurists—the evidence on which upholders of the reality of witchcraft rely no more than the result of leading questions based upon the formulæ devised by heresy hunters.

In working out his thesis, Dr. Kittredge does not follow the usual method of modern writers on witchcraft of describing the trials in chronological sequence. He has preferred to take each branch of magical activity, charms, divination, the wax figure, the Sabbath, and so forth, and follows up the historical evidence in each case. He is thus able to show that all the essentials of magical belief were present in England before the beginning of the reign of Queen Elizabeth; but that it was only after the outburst of feeling against the witch that the Sabbath appears. He directs attention to the patent fact that there is an essential difference between witchcraft in England and on the Continent and in Scotland. While in England witchcraft and witchcraft trials are concerned with specific acts of magic, on the Continent the charges, under the influence of lawyers and theologians, were of a more general character. Witchcraft there is a form of heresy with a definite ritual—in fact, a cult. It is this which gives colour to the theory that there was a highly organised religious body at the back of the witchcraft belief. In England, as Dr. Kittredge points out, the Sabbath first appears in the trial of the Lancashire witches in 1613, and even then, he suggests, it probably had as its base nothing more than a festive meal of the persons accused, which became a ritual feast under cross-examination. Yet there may have been more in it than that. One of the accused gave evidence that he had carried away from Mass a part of the Host, which points to a knowledge of the ritual now known as the Black Mass. Nothing was said as to the purpose of the act, as might have been expected had the fact been elicited by a series of leading questions.

Dr. Kittredge's book, attacking the problem of the witch at a different angle, makes refreshing and entertaining reading after the constant repetition of the evidence of the trials with which students of the literature are more familiar. By its insistence

upon the operations of the witch, it brings medieval witchcraft into line with primitive modes of thought and makes it more amenable to study on comparative lines as a form of religious belief. The notes appended at the end of the book give evidence of great and profound erudition.

Bird Courtship.

An Introduction to the Study of Bird Behaviour. By H. Eliot Howard. Pp. xii + 136 + 11 plates. (Cambridge: At the University Press, 1929.) 42*s.* net.

THE characteristic of this interesting book is that it studies the behaviour of birds as living wholes and in their natural environments. "One reaction in itself is neither more nor less important than another; each forms a portion of the environment for others; each is sensitive to the modification of others—they form a constellation, and somewhere in the organisation of the living bird they have a common structural link." "The whole has value, the parts by themselves have none." It is a piece of work that will greatly please the author of "Holism and Evolution".

Mr. Howard begins with the reproductive behaviour of a reed-bunting, and distinguishes four phases. In the first the female does not figure as a 'situational item', and the male is occupied with his 'territory' or preserve, for example, a certain alder tree and the ground round about. In some measure he continues doing what he did before, making excursions to the feeding ground and meeting his old companions. What is new is his persistent song, his preoccupation with his territory, and his growing hostility towards other males. The old and the new are contrary, yet they persist side by side. In the second phase, about the middle of March, the female begins to play her part, affecting neighbouring males in diverse ways according to their individual physiological state. She is chased with eagerness, but seems to try to escape; for though she excites, she is not herself in a condition to breed. The male fights furiously with rivals; he expresses excitement (*a*) by a new rippling note, low and musical; (*b*) by a peculiar kind of slow sex-flight, now butterfly-like and again moth-like; (*c*) by quite peculiar expansions and vibrations of wings and tail. All the time, however, the alder tree and the rush patch retain their dominant attractiveness for the male. It is only gradually that they extend their influence through him to the female. For at first she is anything but intrigued by sexual excitement on his part, and may indeed fly to another alder and feed with another male, or be chased by several suitors. Gradually, however, as the days pass and her condition changes, she attends to her mate's movements more closely and follows them; she observes his boundaries and becomes attached to the territory; she watches a combat with some excitement; and finally she fights against intruders, fights as her mate fights, though less viciously.

The third phase is marked by coition, nest-building, and the laying of eggs. There is a great change in the female's behaviour, for she now pursues her mate, settles near him, extends and rapidly flutters a wing, and harasses him, as he used to harass her, until she is satisfied. Apparently this beginning of sexual function synchronises with her first hints of nest-building. She breaks off a piece of rush, holds it attentively, flies to the tree, drops it casually, and turns to preen her feathers! A few days later she tears off another piece and lays it in the centre of a clump of rushes near the headquarters of the territory. In a few minutes she does the same for another clump, and for another! About a fortnight after plucking the first piece of rush, her ovary ripens, and she fixes on one of the suggestions of a nest, and builds rapidly. She is assisted by the male, who has been watching her, and has also made some independent experiments of his own. The female's nest-building is curiously punctuated, for after she has worked hard for a short time, usually in the early part of the day, she turns aside and attends to something else. Two or three days pass before the finer strands are added to the nest and the lining made. The last of the five eggs is laid 19-22 days after the first attempt to build. The male is still keen about his territory, but he is mostly silent, and sex-excitement is markedly waning both in him and in her. He may even tolerate a rival male on his preserve.

The fourth phase is marked by the common care for nest, eggs, and young. With this the female is entirely preoccupied; for the male it is a new attraction, but one subordinate to the needs of the territory. "He finds food and distributes it amongst the young, broods, cleans the nest, in fact does all that she does, and may do it with even greater energy." Sexual behaviour has disappeared for the time being, but it is interesting to notice that posturing still persists, in the female at least, though the reaction with which it was formerly correlated has disappeared. Mr. Howard goes on to tell a similar story for the yellow bunting.

The courting bird is moved by constitutional impulses, hereditarily engrained and expressed in a particular sequence, just like other differentiations. The changes in the body as a whole influence the gonads, and these liberate regulative hormones; and the sequence is punctuated by external periodicities of temperature, pressure, humidity, and the like, operating from without inwards. Change of diet is probably in some cases another liberative stimulus, but Mr. Howard does not say much about this.

(1) In the first phase the male behaves in five new ways—seeking an appropriate environment, occupying a conspicuous position, singing, sometimes building, fighting with rivals. He is in a condition to behave sexually if stimulated. (2) In the second phase the female arrives, often unready. The male's song is popularly regarded as evoked by the female's presence; but "instead of singing with renewed vigour, he gives it up and sings but little—perhaps stops". The form of fighting changes, and the male eagerly chases the female, who seems to enjoy it, though not fully responsive physiologically. (3) In the third phase the female begins to posture or to posture in a new way. She may even take the initiative and incite the male. This synchronises with toying with building materials, and changes in the two activities occur simultaneously and are proportionate in intensity. (4) The fourth phase concerns incubation and the care of the young. The female loses susceptibility to sex-stimulation and this reacts discouragingly on her mate. It is difficult to tell what evokes the female's brooding, for she will brood on an empty nest. It is a primary response, rhythmically induced, part of the hereditary pattern, instinctive as many would say, but Mr. Howard declines to use the word. When the young are hatched, their note of hunger is a stimulus to the mother, yet she may bring food to the gaping youngsters and then swallow it!

Soon after the young birds leave the nest the sex-cycle may begin again, but the influence of the offspring remains upon the male more than upon the female. There appears to be some "secondary physiological control" (requiring analysis) which operates in the female, not in the male. Thus when the new cycle begins, she is finished with the young, and ignores their appeal. In the buntings, they would be lost if it were not for the still persistent *paternal* care. Similarly, at a different time the male whitethroat builds before he has been found by a hen, and the male lesser whitethroat not only builds, but also sits upon the nest. He is ahead of her in susceptibility to sexual and parental stimulation.

The next chapter is devoted to the thesis that the inherited pattern of reactions has a unity or combined singleness. The bird is an integrated whole and behaves as such. An important factor in the unification is that a reaction wanes in the course of prolonged excitation, not by muscular fatigue or the like, but in some subtler way like 'fatigue' in a reflex. This waning lessens the risk of overdoing any one line of activity, say fighting, and admits of a harmony of reactions, which makes for the attainment of a common biological end, the production of a brood at an appropriate time. The waning reaction leaves the 'common path' free for a different reaction, and conflict is avoided or lessened. The waning of a reaction under prolonged excitation is an automatic integrative agency.

Howard has gone further than his precursors in working out a connected story of the successive events in the reproductive behaviour, and in showing how they are co-ordinated towards the end-effect. We cannot do more than mention a few instances of this: the fixing on a territory helps towards the subsequent feeding of the young; the conspicuousness of the perch and the song attract the visit of a female; her presence stimulates him and she enjoys the companionship; his experiments in nest-building may arouse her similar activities; the sexual flights may increase intensity of sex-excitement and reaction, and make fertilisation eventually more secure; posturing has probably a self-stimulating as well as mate-exciting function; improvement of weather as the season advances will intensify the reaction, and break down the barrier to fertilisation; even the postponement of a reaction may be pressed into the service of the organism, for it may make for effective timing and intensification. In short, "the actions of male and female combine to form a harmonious whole, beautifully adapted to bring about appropriate synchronisation of rhythms".

The behaviour of birds at the breeding season may be physiologically described as "a neurally linked pattern of reactions for which there is inherited structural provision". Why, then, drag in mind, especially when the reactions are so perfect and so imperative? Moreover, when we are inclined without more ado to credit the bird with intelligent prevision, simple experiments will show that a slight disturbance of routine may cause it to behave in a way that looks exceedingly foolish. But Mr. Howard finds convincing evidence of mind

in the individual bird's establishment of territory. This is a mental edifice reared upon three things—song, hostility, and area. In a certain physiological state a male bird selects a territory that influences or attracts him. From the very first there is a linkage of the bodily excitement and the selected territory; there is heightened perceptor activity and an impression is made upon the bird's organisation. "And this impression is so linked with the pattern of reactions that whenever there is recurrence of the territory situation there is excitation from within of the centres initially stimulated from without and revival in the form of imagery. Hence the trees *A*, *B*, *D*, *H*, *K*, *S*, are not only objective to his mind but are susceptible of revival."

It comes to this, that perception and reference reach a higher level of activity when certain physiological changes are occurring. The bird exercises dominion over his territory, but it also exercises dominion over him. Thus from a distance out of sight, when feeding near his mate or his rivals, he will suddenly make for his tree. There is a revival in the form of imagery whenever there is a return of the bodily commotion which primarily intensified the bird's power of reference. Almost everything the bird does is in reference to his territory; it has a controlling guiding influence; a cognitive reference introduces a prospective factor; and this prospective factor is not disclosed in the physiological part of the story.

Mere sensory stimulation fails to account for the way a male bird behaves to his territory. The physiological story needs to be completed by a psychological story in terms of reference and revival in the form of imagery. Thus mind integrates the reactions.

Mr. Howard's book is one of the most important contributions yet made to the study of bird behaviour. His patient and critical observations show that the courtship has an intricacy, subtlety, and individuality greater than we knew; the sequence of the chapters in the story has been made clearer; the importance of recognising the creature as a whole has been corroborated; and the supposed uselessness of the mind has been disproved. The book is written in a pleasant conversational style, as if the author was taking us with him on his excursions and vigils. We get the suggestion that he has read much of Fabre, for the style is often similar. But perhaps this simply means a similarity of observing genius. The ten plates and frontispiece by G. E. Lodge are masterly.

Vibration Theory and Engineering Practice.

Vibration Problems in Engineering. By Prof. S. Timoshenko. Pp. vi + 351. (London: Constable and Co., Ltd., 1929.) 21*s.* net.

INTRICATE vibration phenomena have at all times attracted the attention of the physical investigator, and vibration theory is a wide field well and fruitfully cultivated by the mathematician. The achievements of pure science and of analytical method in this line are quite remarkable; but in the past the engineer has only had a casual interest therein, the simplest elements of the subject serving his purposes. Within comparatively recent times, however, he has been compelled to change that attitude. The extraordinary advances in size, speed, and type of modern engines have brought in their train a somewhat confused but certainly important series of vibration problems. These have only been reasonably solved under the combined impetus of serious failures, elaborate investigation, and the resources of high theory. The rise, development, and control of these difficulties have been rapid, and it is therefore not surprising that authoritative treatises on the methods of analysis of problems peculiar to vibration phenomena in mechanical engineering are mainly conspicuous by their absence. A warm welcome is therefore to be extended to the present attempt to fill the gap, especially when the author is so able a writer on analytical subjects as Prof. Timoshenko of the University of Michigan.

At the present time it would appear that American and German publishers possess the initiative in this class and standard of publication, which is rather surprising, and scarcely satisfactory, in view of the great contributions made to the analytical and engineering aspects of the subject in Great Britain. The time is certainly ripe for the issue of treatises in English of the class now before us, dealing comprehensively with those theoretical methods to which the greatest practical significance now attaches. The rise of such problems as are connoted by the balancing of high-speed machinery; the whirling of shafts; torsional oscillations in engine arrangements; the vibration of rotating turbine wheels, etc.; have taxed severely—and in some directions, overtaxed—both engineering technique and analytical resource; but the dependence of practice upon theoretical guidance is undeniable; and this book shows it clearly.

Prof. Timoshenko follows a classification in line with theoretical distinctions, and inserts the technical problems in the appropriate order. His

chapters only number four altogether, but each is comprehensive and the full scope of the subject is well covered.

The first chapter deals wholly with harmonic vibrations of single systems. The theoretical work here covers the usual treatment of damped and forced vibrations and is concisely and clearly developed. It is applied to vibrographs, dynamical balancing machines, and first order critical speeds. Useful references are given to sources of information regarding damping effects; and the condition of constant damping is referred to briefly. The energy method of attack is developed and the Rayleigh principle is very usefully introduced. The second chapter deals with matter less familiar to engineers. In it the non-harmonic vibrations of systems having one degree of freedom are discussed. The so-called pseudo-harmonic vibrations, in which the flexibility of the spring depends upon the displacement of the system; and quasi-harmonic vibrations, in which the spring constant is a function of the time, are both considered. The general solution of these is really only possible in certain special cases, but numerical and graphical methods for free and forced vibrations are given. The main technical application made is that of the vibration of the side rod drive systems of electric locomotives—in connexion with which many earlier failures occurred.

In the third chapter the author deals with systems having several degrees of freedom; and in the first part provides an excellent, though brief, theoretical discussion, along orthodox lines, introducing generalised co-ordinates and Lagrange's equations; and outlining the general theory of free and forced vibrations. The subsequent applications are important and include considerations of the vibrations of wheeled vehicles, the torsional oscillations of shaft and geared-shaft systems, the lateral vibrations of multi-bearing shafts, some secondary effects in critical speeds, and the theory of the so-called dynamic vibration absorber. These cases represent schemes in which it is permissible to separate the elastic and mass effects, and so achieve the reduction of fairly complex arrangements to ideal combinations with a limited number of degrees of freedom.

It is left to Chapter iv. to deal with those which cannot be so reduced. It is headed "Vibrations of Elastic Bodies", by which is really implied those continuous systems in which the elastic and mass properties are inseparably associated—systems with infinite degrees of freedom. The general discussion of the vibrations of prismatical bars—longitudinal, lateral and torsional, free and forced—leads towards the treatment of such outstanding engineering matters as the vibrations of beams and bridge girders, impact effects, vibration of ships, turbine blades, etc.; while a discussion of membranes precedes the theory of plate vibration leading to the consideration of turbine disc oscillations. This remarkable practical case of vibration closes the theoretical work of the book, but there is a twenty-page appendix on various instruments for the measurement of vibration. The description of each is brief, but the range is comprehensive and includes vibrographs, torsiographs, strain recorders, and torsionmeters.

The author's scholarship is profound, and the book, in addition to its own wide scope, provides a wealth of references. In the development of the subject matter, symbolism, description, and diagram are all aptly used and skilfully balanced. The volume may be highly recommended to the advanced engineering student. To one well acquainted with, say, Lamb's treatises on mechanics, it opens up wide fields of interesting practical matters and gives new meanings to the abstractions of formal dynamics. It will, however, prove rather difficult reading to most students. It lacks the graduated exercises of the normal text-book, and the theory in places is rather briefly developed. From the point of view of the technical practitioner, it is perhaps a pity that more use was not made of vector methods, and that more specific information on damping effects was not included. In regard to this last, it may safely be asserted that many of the vibrational engineering problems of the moment stand more in need of investigations on damping than of dissertations on theory. Minor criticism apart, however, the author's handling of this highly important subject in mechanical engineering is of great value, and sets a high standard for those other attempts that will assuredly be made in the near future.

Osler's Library.

Bibliotheca Osleriana. A Catalogue of Books illustrating the History of Medicine and Science, collected, arranged, and annotated by Sir William Osler, Bt., and bequeathed to McGill University. Pp. xxxvi+786. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 63*s.* net.

IT is a remarkable fact that the glamour of Osler's name exercises a spell even on the generation that has never known him. Each of

his books reflects something of his philosophy. None tells us more than the few introductory pages "On the Collecting of a Library" that stand at the head of this volume. The humorous yet pious gratitude for early influences and teachers; the vein of melancholy that was scarcely veiled by sparkling fun; the abiding sense of infinite issues that was always fraught with love, all find their place in these few pages. They help us to understand the fortitude and the simple greatness of the man who, finding his dearest human hopes shattered, could turn with more than *aequanimitas* to consider and expound how he could pass on what had most enriched his own passage on earth.

"A library", Osler tells us, "represents the mind of its collector, his fancies and foibles, his strength and weakness, his prejudices and preferences. Particularly is this the case if to the character of a collector he adds—or tries to add—the qualities of a student who wishes to know the books and the lives of the men who wrote them. . . . The years spent in the United States, 1884–1905, brought troops of friends whose affection is part of my life; they brought me, too, into sympathetic touch with another company, those friends of the spirit, the great and good men of the past who, through much tribulation, handed on the torch to our generation. It was the height of my ambition as a teacher to live up to the ideals of Morgan and Rush, of Hossack and Gerhard and Bigelow. . . . To know and to make known to students the lives and works of these men was a labour of love. . . . Gradually, as the books increased, the hope matured into a scheme for a library which would have (*a*) a definite educational value, (*b*) a literary, and (*c*) an historical interest. To break a collection into sections is hazardous, but I consider that, after all, this would form a special part of the Medical Faculty library just as the latter is a section of the University library. So I decided to follow my own plan and group the books into the following divisions:

I. Prima, which gives in chronological order a biobibliographical account of the evolution of science, including medicine.

II. Secunda, the works of men who have made notable contributions, or whose works have some special interest, but scarcely up to the mark of those in Prima.

III. Litteraria, the literary works written by medical men, and books dealing in a general way with doctors and the profession.

IV. Historica, with the stories of institutions, etc.

V. Biographica.

VI. Bibliographica.

VII. Incunabula, and

VIII. Manuscripts."

Thus the vision is placed before us. In the final words of the introduction again we get a flash of light on the man and his thought: "The library is for the use of students of the history of science and medicine without any other qualifications, and I particularly wish that it may be used by my French-Canadian colleagues, who will find it rich in the best of French literature."

So the gifts have reached their destined homes, and above all the main library has made its way to McGill University at Montreal, where it will help not only to keep fresh the memory of a noble soul, but also to stimulate others to the paths that Osler thought worth treading.

To a wider circle than could read the books, Osler hoped that the Catalogue would act as a guide. There are nearly 8000 entries in this volume. The editors have had Osler's own classification on which to base their labours, and in many cases they have appended to the entries notes by him either on the books themselves or on the history of his particular copies. No pains have been spared to give every possible bibliographical information that can throw light on the volumes. Thus every collector of books on the history of science will find this volume an indispensable work of reference. Its helpfulness as well as the pleasure of using it is enhanced by the beautiful printing and set-out of the pages. The Clarendon Press has produced a worthy monument to one of its Delegates, than whom none brought to its service a more vivid appreciation of its tradition nor a more active and effective goodwill towards its fulfilment and enlargement.

DOROTHEA WALEY SINGER.

Theoretical Physics.

(1) *Introduction to Theoretical Physics.* By Prof. Leigh Page. Pp. x + 587. (London: Macmillan and Co., Ltd., 1929.) 35*s.* net.

(2) *The General Properties of Matter.* By Prof. F. H. Newman and V. H. L. Searle. Pp. 388. (London: Ernest Benn, Ltd., 1928.) 25*s.* net.

(1) PROF. LEIGH PAGE covers the usual ground expected of a book on theoretical physics. After an introduction on vector notation and analysis, there follow four chapters on dynamics, two on hydrodynamics, three on thermodynamics and kinetic theory, three on electrodynamics, and three on optics and spectroscopy. The treatment throughout is on classical and essentially mathematical lines, and forms a thoroughly adequate and clear exposition of the analysis associated with the various branches of classical physics. There is an almost complete lack of physics in the book, and in this respect it is somewhat disappointing,

but if there had been more it would have been probably too bulky.

In the details of the book there is little novelty and therefore little to criticise. The definitions of the electric and magnetic force intensities do not allow for possible induction effects, and there is an extraordinary statement on p. 222 about a minimum wind-velocity necessary to generate waves on water being implied by the existence of a minimum value of the velocity of propagation of waves on the surface of water under a stationary atmosphere.

These are, however, small blemishes on an otherwise sound production, which can be strongly commended to English students of physics as a mathematical compendium to the groundwork of their studies in classical physics.

(2) The second volume under notice is, in the words of the authors, an attempt to present a fairly complete survey of the fundamental properties of matter, with the special aim of developing those branches of the subject, such as surface tension, osmosis, and viscosity, which verge towards chemistry, and hydrodynamics and vibrations, which are of importance and interest more particularly to the mathematician and engineer.

While the descriptive parts of the work combine to make a very useful collection of really up-to-date material which should be in the hands of every student of physics, one cannot but feel that the attempt to weave them into a survey of the whole problem would have been more successful had the authors paid more attention to the necessities of logical argument—or cut out the argument altogether. As it is, the numerous attempts at deductive reasoning are spoilt by the omission of step after step until the arguments have become worse than useless and at times positively inaccurate. Take, for example, the way in which an elaborate discussion of gyroscopic motion is based on a chance remark about uniformly accelerated angular motion (in which the whole physics of the problem is hidden) at the end of a paragraph on vectors; or the following sentences, typical of many others too numerous to detail.

"In many general formulæ of motion it is convenient to suppose that, although the particle is in equilibrium, it suffers a virtual infinitesimal displacement" (p. 29).

"If a ball is made to roll down the line of maximum slope of a spherical surface placed with its concavity upwards, the oscillation about the lowest point in the surface will be simple harmonic" (p. 33).

"The distance traversed by a molecule between wo successive collisions is termed the mean free path" (p. 235).

"If the function $f(x)$ to be analysed is given between the limits $x=0$ and $x=l$, then expansion into a Fourier series may be made in three different ways" (p. 270).

In reviewing, as a mathematician, the state of applied mathematics teaching in Great Britain, one is often inclined to suggest that possibly it would be better taught by physicists than it is at present in the hands of the mathematicians, but a book like this makes one hasten to withdraw any such suggestion. G. H. L.

History of Technology.

The Newcomen Society for the Study of the History of Engineering and Technology: Transactions, Vol. 7, 1926–1927. Pp. xi+159+21 plates. (London: Newcomen Society, 1928.) 20*s*.

THE seventh volume of the *Transactions* of the Newcomen Society conforms to the high standard that we have been led to expect. We are beginning to look forward with real pleasure to these annual volumes. The study of the history of technology and industry is, it seems, at last receiving the attention to which the importance and interest of the subject entitle it, and it is a matter of great gratification that Great Britain is now playing its part in the collection, sifting, and evaluation of the available evidence. Germany has hitherto been ahead of us in this respect, for the "Beiträge zur Geschichte der Technik", a publication of the Verein Deutscher Ingenieure, was started so long ago as 1909 and was followed a few years later by two other independent journals of similar scope, both of which are still running. But the Newcomen Society is, so far as we know, the only existing organised body devoted exclusively to the study of the historical side of technology, and as such it is in an excellent position to act as a clearing house for all information on the subject and, by suggesting lines of investigation hitherto but little explored, to stimulate whatever latent desire for research there may be amongst us. That the Society is fully alive to this position seems evident from the work it has already accomplished, and all concerned are to be congratulated on the conspicuous contributions it is making to our knowledge.

The new volume deals with the proceedings and the papers given before the Society during the session 1926–27. The international scope of the Society's activities is here well illustrated, for of the nine original papers printed in the volume, two are concerned with the work of the Swedish

engineers, Christopher Polhem and Martin Triewald respectively, and three are by French writers and relate to Marc Séguin and the early railways of France, whilst some notes on the first steam engine in America were also read at one of the meetings but have not been printed. The contributions from Sweden must be especially emphasised, for their subjects should certainly be better known in Great Britain, and they throw a good deal of light on some of the engineering problems of the early eighteenth century and the way they were attacked. Particularly interesting to us is the connexion of Triewald with England and the new information his 'life' supplies on the early days of the Newcomen steam engine.

Other papers that must be mentioned are the presidential address of Mr. Rhys Jenkins, which passes in review very clearly the rise and progress of manufacturing industry in England up to the eighteenth century, and incidentally dispels the widely held idea that this country was particularly backward industrially in Elizabethan times; an interesting account of early lead mining and smelting in west Yorkshire; and some illuminating notes on Trevithick and his single-acting expansive engine, with special reference to certain MSS. recently discovered. A further instalment of the analytical bibliography of the history of engineering and applied science, containing about 400 entries, is also included. It is noteworthy that in the compilation of these bibliographies the Society is co-operating with the German engineering society and that an exchange of bibliographical material on technological history takes place between them, for inclusion in their respective publications.

The volume is excellently produced and printed and is well illustrated, and should be on the shelves of all engineers.

Grass in Orchards.

The English Grass Orchard, and the Principles of Fruit Growing: an Account of the Cultivation of Cherries, Apples, and Plums on the Grass Orchard Principle. By A. H. Hoare. Pp. 227. (London: Ernest Benn, Ltd., 1928.) 32*s.* 6*d.* net.

NOT everyone will agree with the suggestion in the author's preface that "the value of this book, if any, is due to the attempt that has been made to include the latest results of scientific research work". Such results have already been included in the various leaflets and reports published by the Ministry of Agriculture and by the research institutions, and must surely be familiar to all serious students of fruit growing. For these the value of the book will lie in the chapters dealing with grass orchard management. This is a field which has not yet been thoroughly explored by the research workers, and the present-day planter must therefore depend for guidance upon empirical knowledge.

Mr. Hoare's admirable description of the orchard practice prevailing in the cherry districts of north-east Kent gives just the details which are most useful and at the same time most difficult to obtain. How far the author is right in recommending the planting of permanent fruit orchards must depend upon what are the optimum conditions for the production of high quality fruit. So far as cherries are concerned, there appears to be little doubt, from such evidence as exists, that high quality in the fruit is intimately bound up with well-managed grass, and Mr. Hoare is undoubtedly on safe ground in recommending the establishment of grass cherry orchards where conditions are favourable.

In the cherry districts of Kent, however, a comparatively low rainfall and high rate of evaporation tend to produce a short herbage which is at once the envy and the despair of visitors from other parts. Nor must it be forgotten that the magnificent flocks of Romney Marsh sheep which are to be seen grazing, ten to the acre, on the lawn-like cherry orchards, are the peculiar pride of a race of farmers whose hereditary traditions have linked sheep farming with cherry growing for hundreds of years, and that the local custom of wintering these flocks on marshland pastures has largely solved for them the awkward problem of winter keep. In how many of the twenty-two counties mentioned on page 41 will be found such a happy combination of soil and climatic conditions with local farming practice?

Apart from cherry growing, the case for grass orchards as a means of producing high quality fruit in the most economical manner has yet to be proved. Large acreages of plums are grown on cultivated ground both in the Vale of Evesham and in Kent, and there are those who maintain that high quality apples are most economically produced from low bush trees.

Whatever the truth of the matter may be, Mr. Hoare has stated his case with marked conviction and clearness, although exception might possibly be taken to his figure of £300 an acre as an index to the economic position of the English grass orchard.

Our Bookshelf.

Agriculture and Horticulture.

A Tour in Australia and New Zealand: Grass Land and other Studies. By Prof. R. G. Stapledon. Pp. xv + 128 + 8 plates. (London: Oxford University Press, 1928.) 7*s*. 6*d*. net.

In general, if a man goes to a country for a few weeks, he should not write a book about it, but Prof. Stapledon is an exception, and we welcome this delightful account of his visit to New Zealand and Australia, with its vivid and characteristic touches and its shrewd comments on men and things. It is nominally about grasses, and the author begins by giving himself the rather forbidding title of 'agrostologist'. But as with Dr. Johnson's philosopher: in spite of all efforts "cheerfulness would break out", and so (as we knew he would) Prof. Stapledon breaks out in all directions, uncontrollable but always interesting.

Prof. Stapledon began in New Zealand and has much to say about the fat lamb and the dairy industries (he stayed in Taranaki); like other visitors, too, he soon became impressed by the regrettable fact that Great Britain had almost ceased to count as a supplier of motor-cars and of agricultural implements, both of which are imported in great numbers from America. It is, however, when he gets on to the grazing and the cultivated land that he has most that is new to say. About the herbage he gives valuable information not easily obtained elsewhere, and as a careful observer he makes many helpful comments of ecological and agricultural value. One of the most interesting chapters in the book is called "Followers of Man and his Grazing Animals"; it describes the plants that came in or were brought in after the land was inhabited, and shows how they have settled down as either valuable crops or pestilential weeds. *Paspalum*, *Danthonia*, subterranean clover and others, are described at length, and there is a fund of information about many others.

The casual reader may find some difficulty in disentangling the accounts of New Zealand and of Australia. But whether he reads it casually or studies it closely, the reader will enjoy the book thoroughly, and those of us who have been over the same ground will enjoy it most of all. E. J. R.

Fertilisers and Manures. By Sir A. Daniel Hall. Third edition, revised and enlarged. Pp. xxiii + 414 + 6 plates. (London: John Murray, 1929.) 8*s*. net.

This well-known book has now reached its third edition: the first, which appeared in 1908, was reprinted no less than seven times; the second came in 1921. It presents the knowledge gained by the older field methods—the classical methods—so completely and so lucidly that it is not likely to be supplanted. The basis of the book is still as in 1908, but with alterations and additions to bring the information up-to-date. Teachers who have long used it and know their way through it will welcome it in its revised form; and as the older classical methods are now being given up, it is improbable that any subsequent book will be based upon them quite so completely as this is.

In the new experiments the methods have been altered as the result of the introduction of statistical analysis: the work has been largely done at Rothamsted during the past five or six years, and it has scarcely yet reached a stable position. But it is already clear that the new methods have three great advantages over the old: the results are more accurate, their degree of trustworthiness can be estimated, and, much more important, the field measurements of yield and other quantities can be correlated with other data such as those dealing with weather, soil conditions, etc. For many years these measurements have been taken but not used: comparisons have sometimes been made between a few selected dry years and a few selected wet ones, but the results were always untrustworthy. The new methods open up the hope of yielding much fuller information, but it will be some years before a book can be written about the results; in the meantime, this volume will give the student the information he needs.

The Book of the Tulip. By Sir A. Daniel Hall. Pp. 224 + 24 plates. (London: Martin Hopkinson, Ltd., 1929.) 21*s*. net.

This book has been written as an aid to the gardener or lover of flowers who desires to learn something about the scientific as well as the cultural aspects of the tulip. An account of the life-cycle of plants of the genus is followed by nine other chapters concerned with the history, taxonomy, sporting, hybridisation, and cultivation of wild species and garden races. The chapter on taxonomy is the most interesting botanically, and it is much to be regretted that it is not more complete. The importance of cytological data is well emphasised, and since diploid, triploid, tetraploid, and pentaploid tulips have been recognised as species, knowledge of the chromosome numbers is an aid to both the systematist and the breeder of new horticultural races. The best known species are briefly described, some account is given of their distribution, and cultural details are provided. The value of this chapter would have been much increased had an artificial key to the accepted species been added.

The origin of the garden tulips is wrapped in mystery. That they came to Europe from the Nearer East is practically certain. The great number of 'varieties' is well known, but the extent of the breeding and selecting still proceeding is indicated by the breaking down of the classification proposed by a committee appointed by the Royal Horticultural Society in 1914.

Twelve plates in colour, and an equal number in black and white, illustrate the book. Many of the

plates are fine reproductions of what must be beautiful originals, but some (as the frontispiece) are less satisfactory, and the considerable and varied reductions must be regarded as unfortunate. The plates are unnumbered, though they are referred to by Roman numerals in the text.

W. B. T.

Agricultural Economics. By Prof. George O'Brien. Pp. viii + 195. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 10*s.* 6*d.* net.

It is clearly impossible to deal with a subject so complex and widespread as the economics of the agricultural industry in one little volume; rather does it require an encyclopædia or a library. Moreover, the systematic study of agricultural organisation is of such recent origin that materials are not yet available for a comprehensive survey, and nothing more is possible at this stage of knowledge than an introductory treatment of the whole field, or intensive studies of particular problems.

No one, probably, realises this more clearly than Prof. O'Brien, and in his book, which is an elaboration of a course of lectures delivered to students, he has limited himself to fundamental economic conceptions and to the consideration of scope and method in the examination of the structure of the farming industry. At the same time, the numerous references to published work upon particular aspects of the subject provide the reader anxious to extend his studies with a useful bibliography. The book fills a blank in the agricultural student's library, and fills it well.

Anthropology and Archæology.

On Alexander's Track to the Indus: Personal Narrative of Explorations on the North-West Frontier of India; carried out under the Orders of H.M. Indian Government. By Sir Aurel Stein. Pp. xvi + 182 + 64 plates. (London: Macmillan and Co., Ltd., 1929.) 21*s.* net.

The publication of this book, of which a foretaste was given in the columns of the *Times*, has been eagerly awaited by those—and they are many—who love to follow in the footsteps of Sir Aurel Stein. In this account of his journey in the Valley of Swat in 1926, a twofold attraction is offered his readers. For more than a quarter of a century this had been a 'Promised Land' which political conditions did not allow him to penetrate, though he had seen it from afar. It was, too, ground which previously had been inaccessible to Europeans. Secondly, Sir Aurel was, as his title says, following in the footsteps of Alexander in the memorable campaign to the Indus. In parenthesis it may be noted as a remarkable fact that Alexander does not survive as a figure in tradition or in popular folklore, as might reasonably be expected.

The country which the author traversed is rich in historical relics. It is in this part of the North-West Frontier, where the main routes descend from the Afghan Hills, that India first comes into contact with both East and West. The Aryan invaders, as well as Darius, were Alexander's forerunners, and after his day, under the Indo-Scythians, it was by this route that Græco-Buddhist art and Indian culture spread to Central Asia and China. Much of Sir Aurel Stein's narrative is taken up with his account of the Buddhist relics which he was able to examine. But the principle objective of his expedition was the identification of the stronghold of Aornos which, as narrated by Arrian and Curtius, was held against Alexander by the fugitive Assakenoi and besieged and captured by him. This fortress Sir Aurel Stein holds to have been located on the Pir-Sar range. The topographical and strategic arguments which he marshals in support of his contention are completely convincing. Apart from its archæological interest, Sir Aurel Stein's narrative is an enthralling record, to which a magnificent series of photographs gives added value.

Our Forefathers, the Gothonic Nations: a Manual of the Ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian Peoples. By Dr. Gudmund Schütte. (Published with the aid of Subventions from the Carlsberg Fund and the Rask Ørsted Fund.) Vol. 1. Translated by Jean Young. Pp. xi + 302. (Cambridge: At the University Press, 1929.) 21*s.* net.

"Our Forefathers" is a translation of a volume published originally in Danish in 1926. In his preface, the author explains that his study of the peoples who have contributed to the make-up of the populations of northern Europe is not a book but a skeleton. He modestly disclaims the qualifications for writing a book such as he has in mind. It could, he holds, only be written by a committee of experts. In default of such a committee, and in view of the improbability of such an undertaking being initiated by any but an individual, he has here sketched a history of what he calls the Gothonic nations which will comprehend the material afforded by all the various possible lines of research.

By 'Gothonic' Dr. Schütte covers, broadly speaking, the related peoples who at various times have overrun and settled in the more northerly parts of Europe. In this first volume he deals with them as a major group, considering their names, ethnic position, environment, old home, language, civilisation, and history. In a second volume the individual nations forming the major group will be studied in accordance with the same scheme. Dr. Schütte has a wide and intimate acquaintance with the early literary authorities, and his book will be valuable as a book of reference from this point of view, as it will be also on the philological side of the argument. For the archæologist and student of the anthropology of Europe in early historical times it will rather be found suggestive. The author's special studies in the religions of the peoples of the group are responsible for a valuable section written on comparative lines which is all too brief.

Au pays de Tagore: la civilisation rurale du Bengale occidental et ses facteurs géographiques. Par Dr. Arthur Geddes. Pp. iii + 235. (Paris: Armand Colin, n.d.) 25 francs.

Dr. Geddes' detailed geographical and sociological study of a small area of Bengal is enhanced by his intimate knowledge of the Hindu spirit and ideals derived from long association with Rabindranath Tagore. This has enabled him to see the peasants' point of view and to consider with sympathy the rural civilisation of Bengal and the ideals for its regeneration which have been advocated by thoughtful leaders in India. The volume is thus not only a contribution to Indian geography and sociology, but also has value in any schemes of sane reorganisation in the India of to-morrow.

Materials for the Study of Inheritance in Man. By Franz Boas. (Columbia University Contributions to Anthropology, Vol. 6.) Pp. viii + 540. (New York: Columbia University Press; London: Oxford University Press, 1928.) 50*s*. net.

This book consists of records of measurements of families of immigrants living in New York. It deals mainly with southern Europeans, Scotch, and Hebrews, and the records refer to head measurements, stature, eye-colour, and hair-colour. The records must prove of the greatest usefulness to students of human inheritance, and particularly to those who are studying the effect of a change of environment upon the physical characteristics of the human subject.

Biology.

Die stiftführenden Sinnesorgane: Morphologie und Physiologie der chordotonalen und der tympanalen Sinnesapparate der Insekten. Von Prof. Dr. Friedrich Eggers. (Zoologische Bausteine: Ausschnitte aus dem Gesamtgebiet der Zoologie, herausgegeben von Prof. Dr. Paul Schulze, Band 2, Heft 1.) Pp. vii + 354. (Berlin: Gebrüder Borntraeger, 1928.) 34 gold marks.

The highly differentiated scolopal organs of insects include the chordotonal and tympanal as well as that peculiar organ called the sense organ of Johnston, which is widely distributed in insects in the second antennal segment. Speaking broadly, their function includes not only sound-perception, but probably also regulation of the animal's movements. It is not improbable that in the various orders of insects scolopal organs have arisen independently, and have acquired a general similarity through convergence.

Much patient investigation has been devoted to these interesting organs by a variety of authors, whose results have been published in various scientific publications not always readily accessible. All this work has now been collected and systematically arranged within the compass of a single volume. The value of the book has been greatly enhanced by the contributions from the author's own original researches. Consequently, he has been able to elucidate many obscure features concerning the structure of scolopal organs by his treatment of the subject on a comparative basis.

The structure of the chordotonal organs is carefully reviewed, and their distribution in the insect body and appendages is clearly shown. Johnston's sense organ is similarly discussed in detail, and the section of the book dealing with morphology is terminated by an exhaustive account of the complicated tympanal organs in the Acridiidæ, Gryllidæ, Lepidoptera, and Rhynchota. The description of the histological structure of the scolopal organs is readily followed with the assistance of the numerous well-executed illustrations, and due attention is paid to the physiology of the organs. Terminating the section on morphology there is a useful table summarising our knowledge of the occurrence of all scolopal organs in the individual insect groups and their distribution in the different parts of the insect body.

Concerning the development of scolopal organs, there are many problems still awaiting solution. The development of the tympanal organs of Orthoptera has been extensively investigated by Graber, and the author has greatly increased our knowledge of the corresponding organs in Lepidoptera. A. E. C.

Contribution à l'étude du peuplement des Hautes Montagnes. Par P. Allorge, R. Benoist, A. Chevalier, L. Chopard, L. Germain, H. Heim de Balsac, R. Heim, H. Humbert, R. Jeannel, L. Joleaud, L. Lavauden, R. Maire, E. de Martonne, C. Motas, P. de Peyerimhoff, E. Pittard, J. Sainte-Claire Deville, R. F. Scharf, B. P. Uvarov, A. Vandel. (Mémoires de la Société de Biogéographie, 2.) Pp. 259. (Paris: Paul Lechevalier, 1928.) 55 francs.

A series of twenty-one interesting and individually complete articles by as many authors is published in this book. Together they form a symposium on the subject of life at high altitudes. For the most part it is the mountains of Central Europe (Alps and Pyrenees) and those of the French territories in Africa which form the areas considered. Prof. Martonne has a useful account of the physical conditions found in high mountains, with special reference to the Alps. Prof. Pittard deals with the history and distribution of *Homo alpinus*. Fourteen papers consider aspects of animal life in mountains and include accounts of mammals, birds, insects, and molluscs.

The authors are especially, but not entirely, concerned with the composition, origin, distribution, and dispersal of the groups on which they have specialised. The faunistic peculiarities of high mountains are partly paralleled in the plant world. As an incomplete indication of this, five papers conclude these studies with accounts of North African, Mascarene, and West African high mountain phanerogamic vegetation, of the fungi of the Alps, and of the moss flora of the high summits of the Iberian Peninsula. It is unfortunate that no editorial synthesis is provided of the chief results reached by the different authors. Most of the papers are accompanied by useful lists of literature.

Flowering Plants of the Northern and Central Sudan. By Grace M. Crowfoot. Forming a Companion Volume to the List of Sudan Flora. Pp. xxv + 172 plates. (London: Wheldon and Wesley, Ltd., n.d.) 7*s.* 6*d.* net.

Mrs. Crowfoot's illustrations of the Anglo-Sudan flowers come at a very opportune moment, when tourists are visiting that country in increasing numbers every year. The 163 outline drawings depict the characteristic leaves, flowers, and fruits of the plants generally met with, and the thumbnail sketches of the outline form of some of the more typical trees are a convenient aid to identification of the common objects of the landscape. Each drawing is accompanied by the botanical name, family, vernacular names, and a few lines descriptive of the plant, with a note as to its general occurrence.

The outline figures are followed by eight plates which give a little idea of some parts of the country, whilst two typical plants are shown in the frontispiece. A sketch map shows that the part of the Sudan to which this work refers is that bounded by the Egyptian frontier on the north and the Red Sea and Abyssinia on the east, with an equal distance west of the Nile, and southwards to the beginning of the Sudd region. It pays particular attention to the little known and very interesting vegetation of the Red Sea hills around Erkowit.

Mr. A. F. Broun, lately Director of Woods and Forests of the Sudan, contributes nine introductory pages, in which he gives a useful and interesting sketch of the general features of the vegetation of the northern and central Sudan.

This useful little volume will be welcomed not only by visitors to the country but also by those many residents who find pleasure and relaxation in studying the local flora, to which hitherto there has been no popular guide.

Letters from the Steppe: written in the Years 1886–1887. By William Bateson. Edited, with an Introduction, by Beatrice Bateson. Pp. xvi + 222. (London: Methuen and Co., Ltd., 1928.) 7*s.* 6*d.* net.

In 1886, William Bateson, then a young man of twenty-five years, set out for the Steppe of Asia to test two definite problems of evolution which had stirred his imagination, one distributional, the other adaptational. He summarised these aims in a letter written from Omsk to Sir Sidney Harmer towards the end of his journey on Sept. 8, 1887: "I came to look for two things: firstly, beasts which had lived in the *Asiatic Mediterranean*, and which might be lingering on here; and, secondly, to get the fauna of a great variety of isolated waters in order to ascertain whether these differences of environment produce constant change of form in their fauna." In the first aim he failed, for he found no trace of the gradual extensive shrinkage which had been postulated for the Sea of Aral, but he found great variety of lakes from which he made extensive collections, and he sent home a series of lively letters which, along with extracts from his field note-books, make up this volume.

The letters do not bear much upon Bateson's scientific work, but they give a vivid account of the difficulties, discomforts, even dangers of his journey, and of the Kirghiz peoples amongst whom he lived on terms of equality. Throughout they breathe the enthusiasm, dogged perseverance, and buoyancy of spirit which characterised their writer in later years. The letters and field-notes have been well edited and collated by Beatrice Bateson, who, in a short introduction, sets the stage for the traveller's tale.

The Plant Lice or Aphididae of Great Britain. By Fred. V. Theobald. Vol. 3. Pp. vi + 364. (Ashford and London: Headley Bros., 1929.) 30*s.*

We welcome the appearance of the third volume of this important work, and congratulate its author upon the completion of so laborious a task. It concludes the description of the British Aphides so far as known at present, and will unquestionably form an indispensable aid to all students of the group for a number of years to come. Many more species will no doubt yet be found in Great Britain, and the existence of Mr. Theobald's treatise cannot fail to prove a great stimulus in bringing them to light. The importance of the study of Aphides is increasingly recognised the world over, not only on account of the injurious propensities of these insects, but also because they are now known to be important vectors in the spread of virus diseases from infected to healthy plants. To the general biologist, their reproductive phenomenon, alternation of hosts, and other features have long been of outstanding interest.

The difficulties and expense involved in producing a three-volume book, which can only appeal to a relatively limited circle of buyers, are such as to render all entomologists under a debt of gratitude to the author in seeing it through to completion. In this connexion it is gratifying to note that, through the Ministry of Agriculture, the Development Commission granted the financial assistance necessary to enable this last volume to be printed —a fact which, in itself, testifies to the value of such a book to horticultural and agricultural progress. Like its predecessors the volume is well printed, profusely illustrated, and separately indexed.

A. D. I.

Spitsbergen Papers. Vol. 2: *Scientific Results of the Second and Third Oxford University Expeditions to Spitsbergen in 1923 and 1924.* 25 papers. (London: Oxford University Press, 1929.) 30*s.* net.

The first volume of Spitsbergen papers which was published in 1925 contained the collected results of the Oxford University expedition of 1921. The present volume serves a similar purpose for the two Spitsbergen expeditions under the successful leadership of Mr. F. G. Binney, the Merton College expedition of 1923, and the Oxford University Arctic expedition of 1924. Some papers remain over to form a third volume. All the papers are reprints from various journals and proceedings of

scientific societies, bound together for convenience in reference. The papers are geographical, meteorological, geological, and biological. Many of the biological papers deal with systematic lists of species, but some take a wider outlook. If one may be singled out for mention, it is that of Messrs. V. S. Summerhayes and C. S. Elton on the ecology of Spitsbergen. This should be of interest to all ecologists and all students of the polar regions. Another paper of much importance is that by Dr. K. S. Sandford on the geology of North-East Land. The collection of papers shows how much careful work can be done by a small expedition within the short space of the Arctic summer.

The Botany of Iceland. Edited by Dr. L. Kolderup Rosenvinge and Dr. Eug. Warming. Vol. 2, Part 2. 7: *The Fresh-water Cyanophyceæ of Iceland*, by Johs. Boye Petersen; 8: *The Aërial Algæ of Iceland*, by Johs. Boye Petersen. Pp. 249-447. (Copenhagen: J. Frimodt; London: Wheldon and Wesley, Ltd., 1928.) 8.00 kroner.

Danish botanists are to be congratulated on the thoroughness with which they pursue the investigation of their possessions, and in no group has research been more active than in algæ. Quite apart from the masterly researches by Rosenvinge on the marine algæ of Denmark, papers on the algæ of the Faröes, Iceland, and the Danish West Indies are familiar to all algologists. The most recent treatise completes the series on the freshwater algæ of Iceland. The marine algæ of this island were dealt with by Jonsson in 1912, marine diatoms by Østrup in 1918, freshwater diatoms in 1920, and the freshwater Cyanophyceæ by J. B. Petersen in 1923. Petersen's last treatise (which, it may be explained, is bound up with his "Freshwater Cyanophyceæ" with continuous pagination, in the "Botany of Iceland" series) deals with those land species which he designates Aerial Algæ. Under this term are included all algæ which do not grow in water or are able to grow, in periods at any rate, without being immersed. In addition to the systematic list with critical notes, there is an interesting ecological account occupying 37 pages, and the work as a whole maintains the high standard of the previous publications.

Ants, Bees and Wasps: a Record of Observations on the Habits of the Social Hymenoptera. By Sir John Lubbock (Lord Avebury). New edition, based on seventeenth, edited and annotated by Dr. J. G. Myers. Pp. xix + 377 + 6 plates. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., Inc., 1929.) 10*s.* 6*d.* net.

The popularity of this book is evidenced by the fact that seventeen editions have appeared since 1882. During this period great advances in our knowledge of social insects have been made both in Europe and America. The present edition leaves Lubbock's original text unaltered, but the annotations at the end serve to acquaint the reader with the more important results of recent investigation. In these notes (pp. 249-366) Dr. Myers has greatly enhanced the value and interest of the book, since he brings to notice many interesting facts and theories little known outside the realm of specialists. Lubbock's five coloured plates have been replaced by new ones painted by the well-known entomological artist, Mr. A. J. Enzel Terzi, whose skill is almost unsurpassed. The social Hymenoptera have attracted investigators of the highest order and their discoveries have long interested students of animal behaviour and psychology, as well as appealing to a wide circle of general readers. It is to all of these, as well as to entomologists, that we commend the new edition of this well-known volume. A. D. I.

Agricultural Entomology. By D. H. Robinson and S. G. Jary. Pp. xi + 314. (London: Gerald Duckworth and Co., Ltd., 1929.) 15*s.* net.

This book is an elementary manual of insects affecting agriculture. It is divided into seven chapters dealing with the elements of morphology and classification, and twelve chapters which treat of insects of economic importance together with the principles of their control. There are also appendices on other invertebrates which are of concern to agriculturists. The book is concisely written, well illustrated, and clearly printed, and it should meet the needs of the agricultural student and also prove useful to growers and others interested in pest control.

Vie et réproduction: notions actuelles sur les problèmes généraux de la biologie animale. Par Prof. Max Aron. Pp. xi + 366. (Paris: Masson et Cie, 1929.) 38 francs.

To the Strasbourg school of biology we are greatly indebted for much original work, and of those who are collected round Prof. Bouin, no one has earned a greater reputation than the author of this book, which presents in a very complete fashion an introduction to the study of biology, special reference being given to the facts and theories relating to sex and to reproduction. There is no better book of its kind in the French language than this.

Chemistry.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. (1) System-Nummer 21: *Natrium.* Pp. xxxiii + 992. 150 gold marks. (2) System-Nummer 31: *Radium und Isotope.* Pp. xviii + iv + 80. 15 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1928.)

(1) The enormous amount of labour which is involved in the compilation of the new edition of Gmelin's "Handbuch" may be gauged from the size of the part dealing with sodium, which extends to nearly a thousand pages of closely printed matter, in spite of the fact that it includes only such compounds as the metal forms with elements preceding it in the general scheme of the work. Thus while

the tartrates of sodium come under review, the consideration of Rochelle salt is postponed to a later volume.

In a brief historical introduction it is pointed out that soda and potash were not clearly differentiated (in Europe) until the middle of the eighteenth century, Stahl's previous observations in 1700 that the sulphate and nitrate derived from common salt were different from those obtained from wood-ashes having been generally overlooked. On the other hand, it is recorded that the Indians were aware of the difference between the two carbonates two and a half centuries before the Christian era.

This volume, which is the joint work of twelve collaborators, whose names appear on the back of the title-page, consists mainly of a record of the physical and chemical properties of sodium and of compounds of sodium, without critical discussion, but with copious references to the literature, which has been most carefully reviewed to the end of 1927. The text is illustrated with 75 figures, most of which are phase-rule diagrams. In addition, there are several special sections dealing with technical methods which are used in the preparation of common salt and in the manufacture of caustic soda and other products of the electrolysis of aqueous solutions of common salt. The two parts, dealing with lithium (previously reviewed) and sodium respectively, constitute one complete volume of the whole work.

(2) The much smaller section on radium and its isotopes opens with a summary of general literature on the subject and a table showing the relationships in the different disintegration series. This is followed by a detailed account of the geographical distribution and mineral sources of the four isotopes of element No. 88, together with their physical and chemical properties. There is also an interesting table showing the price fluctuations in gold marks per milligram of radium since 1902. These volumes will be indispensable to the inorganic chemist.

Physikalische Chemie der Silikate. Von Wilhelm Eitel. Pp. xi + 552. (Leipzig: Leopold Voss, 1929.) 80 gold marks.

Dr. Eitel's book on the physical chemistry of the silicates is a very modern work, and is a striking illustration of the enormous progress which has been made in experimental methods during the past thirty or forty years. A book on this subject written during the nineteenth century would have been concerned mainly with empirical formulæ, constructed to represent the bewildering analyses of the silicate minerals, together with drawings and data to represent the external form of the crystals, and their optical properties. These aspects of the problem can still be presented, and substantial advances have been made in our knowledge of subjects such as the distribution of the elements in the lithosphere; but already on p. 19 of Dr. Eitel's book we have reached a section on "The Determination of Crystal Structure by Röntgen-methods", and a study of the still rather limited results obtained by these methods has displaced the mass of crystallographic data which still await a clear interpretation in this way.

Another enormous field of work, on which only a limited range of results has been obtained, is that which is concerned with the application of the phase rule to silicate systems. Work on these lines is far more difficult than in the case of the metals, since the high melting-point of the silicates is accompanied by a low thermal conductivity, and the melts are so viscous that they give rise to glasses even more readily than to crystalline solids; but progress is being made and, in spite of experimental difficulties, no alternative method of study can give such useful information as to the processes involved in the formation of rocks, and the conditions under which crystalline minerals have separated from them.

Dr. Eitel's book deals also with problems such as the measurement of the density, viscosity, surface tension, and electrolytic conductivity of silicate melts, all of which have required the development of special or modified types of apparatus, and with technical glasses and slags. It is therefore an indispensable work of reference for all those whose scientific, professional, or industrial interests are concerned with materials in which silica is a component. T. M. L.

Organic Laboratory Methods. By the late Prof. Lassar-Cohn. Authorised translation from the General Part of the fifth revised edition. By Prof. Ralph E. Oesper. Edited by Roger Adams and Hans T. Clarke. (The World Wide Chemical Translation Series, edited by Prof. E. Emmet Reid, No. 2.) Pp. xi + 469. (London: Baillière, Tindall and Cox, 1928.) 30*s.* net.

An English version of the general part of Lassar-Cohn's familiar "Arbeitsmethoden für organisch-chemische Laboratorien" will be a convenience to many advanced students and research workers in organic chemistry. It deals in a comprehensive manner with the laboratory technique of general operations, such as distillation, dialysis, extraction, filtration, crystallisation, sublimation, and drying; the determination of molecular weight, melting point, and boiling point; and the detection and determination of nitrogen, the halogens and sulphur in organic compounds.

The translation has been made in a commendable manner from the last (fifth) German edition, and the text has been supplemented by a number of useful footnotes; but, as stated in the preface, "the work makes no claims as to completeness . . . new methods are appearing almost every day". In this respect the book possibly invites criticism. As an example, while the thirty-two pages descriptive of methods of determining molecular weight contain little information which is not available in standard text-books, there is no mention of the camphor method of Rast (*Ber.*, p. 1051; 1922), which is now widely used in organic chemical practice. Omissions of this kind could readily have been avoided by inserting brief references to original papers. In other instances, useful references,

contained for the most part in footnotes, are difficult to trace, owing to the incompleteness of the subject index and the absence of an author index. The book is well produced, and there are 186 diagrams in the text. It is not proposed to issue a translation of the second volume of the original work, dealing with general organic chemical reactions.

J. R.

A Concise Summary of Elementary Organic Chemistry. By Dr. F. H. Constable. Pp. xii + 149. (London: Methuen and Co., Ltd., 1929.) 4*s.* 6*d.*

This book is intended to suit the needs of scholarship candidates and others who have not completed their university course. They are expected to have studied the subject elsewhere, since the main facts are merely summarised without discussion. For example, we are tersely told that "on being heated dry the α-hydroxyacids become cyclic double esters (lactides) and may give lactyllactic acids", and "a diazonium salt gives nuclear substitution products (Sandmeyer's reaction) in the presence of suitable catalysts". Occasionally, very brief explanatory notes introduce topics such as optical isomerism, tautomerism and the structure of benzene, but the isomerism of maleic and fumaric acids has been unaccountably omitted.

The use of such books is not without danger, since the mental discipline involved in revision is invaluable, but the present summary is probably much fuller and more compact than private notes are likely to be, and for that reason it will be welcomed by teachers and students. Moreover, it is probable that in using it for revision the student who is beginning to appreciate the subject will frequently need to search the pages of his books of reference in order to comprehend fully the notes which are available here.

The use of the term 'straight chains' is unfortunate, but the general arrangement of the material is good and misprints are infrequent. The book may well justify the author's boldly expressed hope that it "may help to shorten the time and labour spent on elementary work, so that the earnest student may the more rapidly be in a position to make his own contribution" to this very wide subject.

Volumetric Analysis: with a Chapter on Simple Gravimetric Determinations. By A. J. Berry. (Cambridge Physical Series.) Fourth edition. Pp. vii + 154. (Cambridge: At the University Press, 1929.) 6*s.*

That this little book has established its position is shown by the fact that three fresh editions have been called for since its first appearance in 1915. Little remains, therefore, except to offer one or two suggestions.

The varying strengths of 'normal' solutions of, for example, potassium bi-iodate (p. 5), according as it functions as an acid or as an oxidising agent, would be avoided by the use of 'molar' solutions, a scheme gaining much favour abroad. Examples are given (pp. 98 and 99, not pp. 96 and 97 as in the index) of the use of potassium iodate as oxidising agent, but the practically valuable bromate process for antimony (atomic weight 121·77, not 120·2 as given on p. 144) is worthy of inclusion. Mention might advantageously be made of units of volume to the possible exclusion of the chapter on simple gravimetric determinations, the merits of the inclusion of which in a book entitled externally simply "Volumetric Analysis" appears uncertain.

These comments, however, in no wise detract from the general utility of a book of this type, for a large field is covered in relatively little space and at small cost, while the revision which the frequent editions permit keeps a useful little volume up-to-date.

B. A. E.

Applied Chemistry; a Practical Handbook for Students of Household Science and Public Health. By Prof. C. Kenneth Tinkler and Helen Masters. Vol. 1: *Water, Detergents, Textiles, Fuels, etc.* Second edition, revised. Pp. xii + 296. (London: Crosby Lockwood and Son, 1929.) 15*s.* net.

Examinations involve courses, and these necessitate text-books, so that the diligent student may imbibe just so much of a particular subject as will enable him or her to pass and no more—all most satisfactory for the student but a disaster from the point of view of the acquisition of real culture and of the knowledge how to learn. However, the sin is that of the senate and the framers of a syllabus, and must not be visited on the humble writers of text-books.

In this case the subject is that of household and social science, now elevated to the status of a degree, and the science that of applied chemistry, which is of sufficient magnitude to be dealt with in two volumes. The fact that this is the second edition, and the status and achievements of the joint authors, are sufficient to guarantee that the book is thoroughly and carefully done, and our own perusal of the volume has satisfied us on this point. But how sad and how dull to be forced to learn the chemistry of everyday life in such a manner so as to pass an examination—how the students must envy their forbears who lived in the days of the old still room books such as the "Closet of Sir Kenhelm Digby" and from them really learned domestic science.

All the same, we congratulate the authors on a very satisfactory production.

E. F. A.

The Foundations of the Theory of Dilute Solutions. Papers on Osmotic Pressure, by J. H. Van't Hoff; and on Electrolytic Dissociation, by Svante Arrhenius. (Alembic Club Reprints, No. 19.) Pp. 67. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1929.) 2*s.* 6*d.*

Without waiting for a jubilee, which is not due for another eight years, the editor of the Alembic Club Reprints has provided an English translation of the papers by van't Hoff on osmotic pressure and by Arrhenius on electrolytic dissociation, which appeared in the first volume of the *Zeitschrift für physikalische Chemie* in 1887. These will be of real value to teachers and students alike, since they will

make it easy, especially for those who dislike the effort of reading German, to obtain a first-hand knowledge of the early work of the group of actors who for so many years occupied the centre of the stage on which the newly labelled cult of physical chemistry was displayed. Modern workers have thrown grave doubts on the validity of the deductions which were then made with so much confidence, and have used as evidence of discrepancy the same data which were formerly cited as evidence of concordance between theory and experiment; but for this very reason it is all the more important that the original texts should be accessible. The reprint would have been of even greater value if it had included the critical but constructive work of Debye and Hückel, but it seems likely that the rules of the Alembic Club prohibit the payment of such a compliment to contemporary workers. T. M. L.

Industrial Carbon. By Dr. C. L. Mantell. (Industrial Chemical Monographs.) Pp. ix+410. (London: Chapman and Hall, Ltd., 1928.) 21*s*. net.

The author remarks that, although the industrial applications of carbon are numerous and very specialised, the literature on the subject is scattered and often contradictory. He has therefore performed a very useful service in presenting the information on the technological uses of elementary carbon, apart from fuels, in a compact and critical form. The subjects dealt with include diamonds, natural and artificial graphites, carbon black and lampblack, adsorbent charcoal, electrodes and brushes, arc carbons, refractories and minor uses. The treatment is good, although the information on active carbons is rather sketchy and not easily followed. The treatment of electrodes is full, and here, as in other parts of the book, there are useful tables and curves.

The book is one which should be found of great service to the many users of carbon in one or other of its forms, and includes much information not easily obtainable elsewhere. It is well printed and illustrated and provided with an index. The references to the literature are not very numerous, and in a future edition the bibliography might with advantage be extended. This would most usefully take the form of a selection of works and papers which themselves include bibliographies rather than a mass of references (generally inaccurate), which is too often what is found in technical literature.

Inorganic Chemical Technology. By Prof. W. L. Badger and Prof. E. M. Baker. (Chemical Engineering Series.) Pp. viii+228. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 12*s*. 6*d*. net.

Although the authors limit themselves to American practice, their method of dealing with industrial processes from the engineering point of view rather than from that of the industrial chemist is generally applicable, and their choice of material is good. The amount of detail is carefully chosen to correspond with the limits of the work, and although quantitative data are given throughout, no attempt has been made to produce a book of reference. Numerical problems are given at the ends of sections, and there is a limited but useful bibliography. This book is one which should prove valuable to students proposing to enter industry, and the average chemical student will find it convenient in supplementing the information given in the usual text-books. The most modern developments in processes are described, and the illustrations are very good.

A General Discussion on Homogeneous Catalysis held in the Physical Chemistry Laboratory of the University of Cambridge, on Friday and Saturday, 28th and 29th September 1928. Pp. iii+545-740. (London: The Faraday Society, 1929.) 12*s*. 6*d*.

This volume contains the papers presented at the fiftieth discussion arranged by the Faraday Society, and, like the preceding ones, it serves a useful purpose in bringing together many lines of development of a subject. It is divided into three parts, dealing with general relations, intermediate addition compounds and chain reactions, and neutral salt and activity effects. There are about six papers in each section, and these are followed by a general discussion of all the sections. Prof. Lowry contributes a conclusion, in which the main points raised are summarised. The volume exhibits a diversity of opinion rather greater than usual in these discussions, and some space is taken up with claims for priority which are out of place in such a publication. The volume is one which will be found most useful by research workers and students. An account of the main issues raised was given in Nature of Oct. 13, 1928, p. 589.

Engineering.

(1) *The Ventilation of Mines: Generation of the Air Current.* By Prof. Henry Briggs. (Methuen's Monographs on Coal-Mining.) Pp. xiv+136. (London: Methuen and Co., Ltd., 1929.) 7*s*. 6*d*. net.

(2) *Mining Subsidence.* By Prof. Henry Briggs. Pp. vii+215. (London: Edward Arnold and Co., 1929.) 14*s*. net.

(1) Prof. Henry Briggs, Hood professor of mining in the University of Edinburgh, is the general editor of Messrs. Methuen's monographs on coal-mining, of which the volume on "The Ventilation of Mines" is one. Based on lectures given in the Royal School of Mines in 1927 and afterwards amplified in *Colliery Engineering* during the following year, the book treats of the flow of air in galleries, control of ventilation, various types of fans, measurement of pressures, and fan testing. Efficiency in ventilation is an important economic problem, and in some collieries the actual weight of the air put through per day is stated to be as much as ten or twelve times the tonnage of coal extracted. In a certain Prussian mine the fan is nearly 30 feet in diameter: it is rated to deliver 710,000 cubic feet per minute against a $14\frac{1}{4}$-in. water gauge and is driven by a steam engine of 2140 h.p.

(2) In the second volume under notice, Prof. Briggs gives examples of the damage to buildings, bridges, tunnels, roads, railways and water, gas,

and electricity mains, and reviews briefly the law governing mining subsidence in Great Britain. He presents a critical summary of the more important theories of subsidence which have been brought forward and discusses the methods used for mitigating the damage to property. Two chapters are devoted to the observations made in Great Britain, America, and India on the occurrence of subsidence. Prof. Briggs also deals with the bending of the strata and the fracture due to shear, and gives his conclusions regarding the mechanism of mining subsidence.

Though addressed particularly to members of the coal-mining profession, the book refers to a subject which in some parts of Great Britain is of great importance to lawyers, architects, engineers, public utility companies, and local authorities.

Operational Circuit Analysis. By Prof. Vannevar Bush. With an Appendix by Prof. Norbert Wiener. Pp. x + 392. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 22*s.* 6*d.* net.

The literature on the subject of operational circuit analysis is now quite extensive. Authors are simplifying and developing the methods introduced by Oliver Heaviside in his "Electrical Papers" and in his "Electromagnetic Theory". Yet beyond a recent paper published by Dr. Sumpner in the June number of the *Proceedings of the Physical Society*, there are few books or papers which explain these methods in a way that can be understood by physicists and engineers. Some use these methods without understanding in the least the mathematics of the differential equations on which they are based; they are, in fact, simply computers.

Heaviside usually evaluated his operators by expanding them in series and applying them term by term to the original function. This process has the advantage that only elementary mathematics is needed. In many cases, however, when the legitimacy of the steps is examined carefully, pitfalls are found which it is necessary to avoid. In dealing with series developments of operators, it is only too easy to get off the track. Sometimes we have to use series which converge up to a certain term and then they begin to diverge. It is absolutely necessary to know where to stop.

Prof. Bush emphasises the fact that he writes as an engineer and not as a mathematician. To engineers, this book will be found helpful. The mathematicians now treat Heaviside's operator on the lines of a complex variable and submit it to contour integration (see a paper by the late Dr. Bromwich in the *Proc. Lond. Math. Soc.*, **15**, 401-408; 1916). He shows that if the operators are interpreted in the form of complex integrals, the slippery places reveal themselves at once.

Electricity Applied to Mining. By H. Cotton. Pp. xi + 625. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 35*s.* net.

Recent events in the mining industry point conclusively to the fact that its continued existence necessitates that old methods and old machinery should be ruthlessly scrapped, and that electric power should be used to a far greater extent than in the past. We are glad, therefore, that in this volume the more recent methods and modern specialised plant are adequately discussed. In the earlier chapters the usual academic discussion of generation and distribution is given. Later on, when describing the electrical gear requisite for any particular drive, full particulars are given of the peculiar characteristics of the drive. For example, the operating engineer must know whether it is a fan, a compressor, or a pump. Speed regulation is of great importance with certain drives, and the author rightly lays stress on this.

The increased capacity of the machinery now available for handling the coal taken from the coal-face makes the replacement of hand labour by machine coal cutting inevitable. The actual process of coal winning is of greater importance than pumping, ventilating, or hauling. It is not economical to retain hand labour in a pit where the use of coal cutters is permissible. It has been calculated that about three times the output can be obtained from a given working face by using machines instead of hand labour. The motive power used for the coal cutter is either electricity or compressed air. In certain districts, especially in South Wales, the seams are so 'gassy' that compressed air must be used. On the other hand, in Scotland, where the mines are not gassy, the motive power for the coal cutters is nearly always electricity. We hope that many collieries will be able to obtain power from the national high tension mains.

Engineering Economics. By T. H. Burnham. Pp. xiii + 326. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 10*s.* 6*d.* net.

At the time of the inclusion of the subject of engineering economics in the syllabus for the examination for the associate membership of the Institution of Mechanical Engineers, there was no general text-book to which students could go for guidance in their studies. Attempts have been made to supply this need, and among the most successful must be placed this book by Mr. Burnham. Engineers who rise to the head of their profession are often more engaged in questions of administration than in questions of design and production, and some of the matters on which they have to be informed are indicated by the chapters in this book, namely, finance, foreign exchange, joint-stock companies, insurance, organisation, industrial legislation, and research.

The industrialist often asks: Does research pay? This, to our mind, is a curious question when one remembers that the steam engine is the direct outcome of the discovery of Torricelli of the pressure of the atmosphere, that our knowledge of electricity really begins with Gilbert's work, and our knowledge of the laws of motion with that of Galileo. Pasteur was one of the world's greatest investigators, and it was Huxley who said, "Pasteur's discoveries have brought France more

than the five milliards of indemnity paid to Germany after the war of 1870". Mr. Burnham rightly says, "Scientific research is essential to any attempt to develop or expand British industry".

Steam Turbines. By Eng. Lieut.-Comdr. T. M. Naylor. Pp. viii + 207 + 13 plates. (London: Chapman and Hall, Ltd., 1929.) 12*s.* 6*d.* net.

This book takes rather an unusual form and is perhaps best described as being something intermediate between a textbook and a handbook. It is primarily designed to meet the requirements of engineering students in their final years at colleges, etc., and for this purpose should prove exceedingly useful. The object throughout is to give all essential information without any unnecessary overloading. Fundamental and derived formulæ are given with a skeleton connexion between them. This method of presentation not only gives all that is really necessary, but also provides a little mental stimulus in following the steps.

In the interests of brevity, the general treatment of the properties of steam, thermodynamics, and the theory of lubrication have been entirely omitted, it being considered that these subjects will have been dealt with in a more general study. A chapter on condensers is wisely included, since the vacuum requirements of turbines are special to themselves. The descriptive matter is concise but not quite up-to-date. As an example, the recent development of marine installations having reciprocating engines and exhaust steam turbines is not mentioned. This defect, however, is a consequence of the rapid progress made in this branch of engineering, and is an almost general characteristic of books on this subject. A future edition would be improved by some addition and a little elimination of described examples.

Geology and Geography.

Die Kriegsschauplätze 1914–1918 geologisch dargestellt. In 14 Heften. Herausgegeben von Prof. Dr. J. Wilser. (1) Heft 6: *Reims, La Fère und Ardennen.* Von Dr. C. Schnarrenberger. Pp. iv + 45. 8 gold marks. (2) Heft 7: *Artois und Hennegau.* Von Prof. Dr. H. Stille. Pp. vi + 40 + 2 Tafeln. 14 gold marks. (3) Heft 10, Teil 2: *Bodenschätze im Ostbaltikum (Ostbaltikum,* Teil 3). Von Dr. C. Gäbert und Prof. Dr. H. Scupin. Pp. vii + 112 + 1 Tafel. 16·80 gold marks. (Berlin: Gebrüder Borntraeger, 1928.)

Three more of the expensive monographs on the geology of the fields of War have now been issued. (1) The sixth in the series is an account by Dr. C. Schnarrenberger of the district between Rheims, La Fère, and the Southern Ardennes. It includes an account of the Jurassic iron ores, of the Cretaceous rocks of this district, and of the Kainozoic between the Montian, which is left in the Cretaceous, and the Aquitanian, which is included in the Oligocene.

(2) Prof. Stille of Göttingen describes Artois and Hainault (Hennegau), where the rocks range from the Palæozoic to the Cretaceous, and, after the Lamaride folding, to the Kainozoic, of which in one respect his classification is less satisfactory than that of Dr. Schnarrenberger; his Palæocene includes the Landenian, which is said to be overlain by the Lower Eocene Thanetian, and thus reverses the sequence of the ordinary correlation. The most interesting section in this book is the account of the distribution of the ground-water which was such an important influence during the War on the trenching and mining. The memoir is illustrated by valuable hydrogeological maps and sections.

(3) The mineral deposits of Esthonia are described in the second part of No. 10 of the series. The useful minerals are varied and include materials used for building, cement, and bricks; there are also various mineral springs and peat. The two most important are the Ordovician phosphates and the oil shale, the remarkable kuckersite, which has been known since 1777. The author shows that its age is Middle Llandeilo; he gives a valuable account of the origin of the economic constituents in both the phosphates and oil shale.

Westward to Mecca: a Journey of Adventure through Afghanistan, Bolshevik Asia, Persia, Iraq and Hijaz to the Cradle of Islam. By Sirdar Ikbal Ali Shah. Pp. 224 + 12 plates. (London: H. F. and G. Witherby, 1928.) 12*s.* 6*d.* net.

This is an account of the adventures of an Afghan sirdar in the course of a journey from his native country to Mecca. The journey may be performed in two ways — the shorter, the sea route via Karachi or Bombay, or the longer way, round through Afghanistan, Persia, Iraq, and the Arabian desert to the City of the Prophet.

The longer the route, however, the greater the merit, so after a preliminary failure to take the shorter route, our author determines to make his way from India across the Himalayas, Central Asia, Persia, Iraq, and thence across Arabia to the Holy City. His first attempt failed, as the friend he was travelling with died in the Himalaya mountains, and he had to return to India and start afresh via Kabul, Persia, and Turkistan. Eventually he reached Baghdad, but finding he could not continue his journey by land, owing to the disturbed state of affairs on the Arabian frontier, he decided to go by sea to Bombay and start again from there in one of the pilgrims ships, and so to Jeddeh and Mecca.

The author certainly did go the longest way round, and we must hope acquired corresponding merit. We scarcely know what to make of the somewhat extraordinary adventures he had on this long drawn out journey, they seem to be so different from those of which one generally reads. The book is well illustrated, but contains no map. It may be recalled that the author broadcast a talk on Afghan affairs a short time ago.

H. L. C.

Some Notable Surveyors and Map-Makers of the Sixteenth, Seventeenth, and Eighteenth Centuries and their Work: a Study in the History of Cartography. By Sir Herbert George Fordham. Pp. xii + 99 + 4 plates. (Cambridge: At the University Press, 1929.) 6*s.* net.

This book has a melancholy interest, as the author, Sir Herbert George Fordham, has died since its publication, only this year. Sir George was a well-known map collector, and, we believe, had one of the finest collection of old maps in England, which he exhibited on several occasions, notably at the Southampton meeting of the British Association. A list of his works on the subject of ancient maps and cartography shows how widely and deeply he had studied the subject. As a historian of maps he will be a great loss.

The present volume begins with a sketch of the Elizabethan surveyors and their methods; gives an account of the French school of cartography in the seventeenth century and its development as an exact science under the influence of the Cassini family. The last part of the book treats of British cartography in the second half of the eighteenth century, and the connexion of the triangulations of England and France, which marks the beginnings of the Ordnance Survey. Specimens of maps of various dates are given, together with a useful list of works of reference. H. L. C.

Mathematical and Physical Sciences.

Quellen und Studien zur Geschichte der Mathematik. Herausgegeben von O. Neugebauer, J. Stenzel, O. Toeplitz. Abteilung B: *Studien.* Band 1, Heft 1. Pp. 112. (Berlin: Julius Springer, 1929.) 12 gold marks.

We have here the first part of a new series which is to contain sources (Section A) and studies (Section B) of the history of mathematics. The sources are to consist of original texts with translations and all necessary elucidations. No parts of this section are yet to hand; we shall welcome them when received. Three papers in the present part of Section B are on the relation of Plato and Aristotle to certain developments in mathematics; two of them connect themselves with recent efforts to find in one of the principles of Plato's idea-numbers, the 'indefinite dyad', or the 'great and small', gropings after a system of numbers which shall include not only integers but irrationals, after the fashion of G. Cantor and Dedekind.

Of more direct mathematical interest are two papers containing accounts of old Babylonian mathematical texts recently published. One type of problem is the mensuration of parallel-trapezia obtained by cutting a right-angled triangle by one or more straight lines drawn parallel to one of the perpendicular sides. One such problem amounts to finding five unknown quantities from five equations. Certain cases in which there is only one parallel and therefore only one trapezium lead to the equivalent of 'mixed' quadratic equations; and we are assured that another document to be published in the series will show that the Babylonian solution of such equations was, step for step, equivalent to ours. Some calculations of the heights of segments of circles from their bases and vice versa imply a knowledge (1) of Thales' proposition that the angle in a semicircle is a right angle, and (2) of Pythagoras's theorem of the square on the hypotenuse. Numbers are expressed on the sexagesimal system (but without any sign for zero); the successive sexagesimal fractions are also consistently used. A remarkable fact is that, when the Babylonian wishes to calculate a fractional part of a number, he turns the fraction into a sum of successive sexagesimal fractions and *multiplies.*

It cannot be denied that the publication of these fragments throws new light on the ancient Babylonian mathematics. The authors use the expression "old Babylonian"; but we should welcome the assignment of an approximate date to the documents. T. L. H.

Soap Films: a Study of Molecular Individuality. By A. S. C. Lawrence. Pp. xi + 141 + 17 plates. (London: G. Bell and Sons, Ltd., 1929.) 12*s.* 6*d.* net.

No fuller or more useful book on soap films than Mr. Lawrence's new volume exists, or indeed will be needed until considerable further research has been done. It is extremely thorough, giving a most detailed account of all important work, and much that has hitherto remained unpublished, or buried in hasty description in an obscure corner of an original paper, is here set forth for the first time. Although nothing of any importance seems to have been omitted, and full literature references are given, the book is nevertheless extremely readable. Sufficient of the chemistry and physical chemistry of soaps is given to enable the reader to fix the relation of these films to other branches of knowledge, with which he may perhaps not be fully familiar before reading the book; and any special points of physical theory used in the study of soap films are briefly explained, so that nothing beyond an elementary acquaintance with physics and chemistry is required of the reader.

The book is excellently got up, and Mr. Lawrence is admirably equipped for writing it, for not only has he himself repeated Perrin's most intriguing work on the stratification of soap films under the influence of dyes and light, but he also acted as assistant to Sir James Dewar for some time. When one reads that in the cellars of the Royal Institution a soap film was once kept unbroken for three years, and considers that the ordinary mortal is proud of a soap bubble which lasts a couple of minutes, the discernment of the writer of "Biography for Beginners" (about 1910), when referring to earlier achievements, will be endorsed.

> "Sir James Dewar
> Is a better man than you are;
> None of you asses
> Can condense gases."

The book is, however, an independent survey of the subject, and by no means a mere reflection

of someone else's views; it is heartily to be recommended, not only as a work on soap films, but also as an introduction to other related subjects in which great advances in our knowledge have recently been made. N. K. A.

Air Ministry: Meteorological Office. Réseau Mondial 1922: Monthly and Annual Summaries of Pressure, Temperature and Precipitation based on a World-wide Network of Observing Stations. Published by the Authority of the Meteorological Committee. (M.O. No. 314.) Pp. xvi + 115. (London: H.M. Stationery Office, 1929.) 25*s.* net.

The Meteorological Office publication dealing with the year 1922, known as the "Réseau Mondial", has recently been issued from the Air Ministry. It contains monthly and annual summaries of atmospheric pressure, temperature, and precipitation for 1922 for a world-wide network of stations arranged according to a definite plan on the lines of the earlier numbers, which start with the volume for the year 1911.

The system of representation adopted involves primarily the division of the globe into zones extending over ten degrees of latitude, and these are in each case further divided into thirty-six 'squares' covering ten degrees of both latitude and longitude, generally with two representative stations, but sometimes more. This formidable mass of statistics is unaccompanied by any brief summary of what may be revealed by them to the expert eye about the particular character of the year under consideration, as compared with other years, and the casual student of meteorology will therefore gain little from its perusal, but one of the many uses to which such a work may be turned by the expert is shown by recent papers on the radiation of the earth and its atmosphere by Dr. G. C. Simpson, Director of the Meteorological Office, in the series of memoirs of the Royal Meteorological Society. The kind of information given is clearly suitable also for studies of large scale meteorological anomalies such as the cold European and North American winters of 1928–29, and the recent run of wet years in the British Isles.

The volume under review does not differ greatly from earlier volumes, but is an advance over them in that the introduction of information from the oceans, made on a very limited scale in the volume for 1921, is here extended to include considerable areas in the North Atlantic and North Pacific Oceans.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 9, Teil 1: *Hohe und tiefe Temperaturen*, von Prof. H. von Wartenberg; *Gasverflüssigung und ihre thermodynamischen Grundlagen*, von H. Lenz; *Wärmeleitung*, von Prof. Osc. Knoblauch und H. Reiher; *Wärmestrahlung*, von W. Wien und Dr. C. Müller. Pp. xiv + 484. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 44·60 gold marks.

The first section of this book contains a practical and useful account of high-temperature ovens and enclosures and low-temperature baths, and of methods of temperature measurement. The second section deals with the liquefaction of gases. It includes a summary of the most important experiments on the Joule-Kelvin effect, and a descriptive account of the methods used at Leyden and at the Reichsanstalt for the production of liquid hydrogen and liquid helium. Unfortunately, the proof-readers of this part have overlooked a considerable number of algebraical errors and inconsistencies.

The third section, on the transfer of heat, is written with an emphasis throughout on work which is of importance in technical applications. The experimental work on conduction in metals and solid 'insulators' is dealt with in detail. It may be noted that the accurate work of Hercus and Laby on the conductivity of air has been overlooked. A useful account of work on the loss of heat by convection is included.

In the first chapter of section four a brief sketch is given of the thermodynamical theory of radiation. The second chapter deals with the statistical theory and includes a short account of Saha's theory of the temperature radiation from gases. The third chapter includes an account of instruments for the measurement of heat radiation; also of standard sources of radiation, and of the measurement of the pressure of radiation. The fourth chapter deals with the measurement of Stefan's constant, and the fifth with the experimental determination of the distribution of energy in the spectrum of a black body. The third, fourth, and fifth chapters form a useful and interesting summary of the experimental work. J. K. R.

Der vierdimensionale Raum. Von Prof. Dr. Roland Weitzenböck. (Die Wissenschaft, Sammlung von Einzeldarstellungen aus den Gebieten der Naturwissenschaft und der Technik, herausgegeben von Prof. Dr. Wilhelm Westphal, Band 80.) Pp. viii + 142. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 9 gold marks.

Prof. Weitzenböck's little book deals with the fourth dimension from many points of view, including those of geometry, physics, religion, spiritualism, metaphysics, mysticism, and phantastic fiction, and ends with an extensive bibliography. The greater part of the discussion, intended for the general reader, will be found easy and even amusing, but the author insists that a mathematical foundation is necessary, and some parts of this will be found rather difficult.

In abstract geometry, regarded as a set of logical deductions from certain axioms which are merely unproved statements concerning certain undefined terms, the number of dimensions may be any we please. Some geometers, following up Geiser's discussion of the bitangents of a plane quartic curve by means of an associated cubic surface, have found it advantageous to use four-dimensional loci in order to obtain properties of three-dimensional ones. These properties cannot be regarded merely as abstractions, for they can be verified, to a high degree of approximation, by constructing models. By the aid of analogy and analytical geometry,

thinking in four dimensions can be cultivated so as to become almost intuitional.

The application of four-dimensional space-time to relativity is now well established, but the attempts made about fifty years ago to explain physical phenomena by assuming a fourth dimension of space alone met with no success, and have now been almost forgotten. H. T. H. P.

Lehrbuch der Physik in elementarer Darstellung. Von Arnold Berliner. Vierte Auflage. Pp. v + 658. (Berlin: Julius Springer, 1928.) 19·80 gold marks.

The fact that after an interval of only four years a new edition of Dr. Berliner's text-book of physics has been called for, is sufficient testimony to the quality of his work. A comparison of the fourth with the third edition shows that the text has been carefully revised and a considerable amount of additional information has been incorporated. Although the subject matter has been amplified, the number of pages is nearly the same as before. It is, perhaps, to be regretted that the table of contents is so greatly reduced and the chronological table at the end of the volume omitted. Some of the diagrams have been diminished in size and the appearance of the pages is slightly less pleasing than that of the earlier edition. But in view of the continual growth of scientific knowledge, how is an author or a publisher to meet the new conditions? We notice new sections dealing with tops and gyroscopes and with Coriolis motion. The important subject of crystal structure receives fuller treatment, and Dr. Haber contributes a useful section on flames. The additions in connexion with atomic physics are valuable and up-to-date; there is, for example, a paragraph on the experiments of Stern and Gerlach in proof of the theory of quantisation in space, and a couple of pages dealing with the Compton effect. It is remarkable how much information the author is able to convey in a clear and interesting manner in a small space.

H. S. A.

Le théorème de Picard-Borel et la théorie des fonctions méromorphes. Par Prof. Rolf Nevanlinna. (Collection de monographies sur la théorie des fonctions.) Pp. vii + 174. (Paris: Gauthier-Villars et Cie, 1929.) 35 francs.

In elementary algebra the well-known remainder theorem enables us to determine a polynomial, except for a numerical factor, when all the zeroes are given. If we replace the polynomial by an integral function with an infinite number of zeroes, we can still determine a good deal about the function, though not so much as about the polynomial. In 1879 Picard proved a theorem which at that time appeared to have no connexion with the preceding results. He showed that a function that is uniform in the vicinity of an isolated essential singularity takes infinitely many times every value with the possible exception of two. Much later Borel and others linked up these two subjects of investigation, and studied the distribution of values of a complex variable for which a meromorphic function is equal to a given constant. This is the principal topic dealt with by the book under review. The discussion is based on the Poisson-Jensen formula, which connects the modulus of a meromorphic function at any point within a circle with its values on the circumference and the position of its zeroes and poles inside. For lack of space, Prof. Nevanlinna confines himself to a consideration of the *moduli*. The other half of the problem, the discussion of the *arguments* of the roots, can be found in Valiron's "Lectures on the General Theory of Integral Functions" (Toulouse, 1923) and elsewhere.

H. T. H. P.

E. Lechers Lehrbuch der Physik: für Mediziner, Biologen und Psychologen. Fünfte Auflage, bearbeitet von Prof. Dr. Stefan Meyer und Prof. Dr. Egon Schweidler. Pp. ix + 469. (Leipzig und Berlin: B. G. Teubner, 1928.) 18 gold marks.

Any text-book of physics which seriously attempts to show the young medical student that a knowledge of physics is certain to be of real use to him in his future career certainly deserves to be brought to the attention of teachers of physics. The fifth edition of Lecher's text-book has been edited by Stefan Meyer and Egon Schweidler, whose names are sufficient guarantee of its excellence. It covers a rather wide range for an introductory course of physics, but the more advanced portions are dealt with quite briefly and may easily be assimilated. It is very well illustrated, and no pains have been spared to collect examples of the physical measurements necessary in physiological or medical practice.

Medical Sciences.

Blood: a Study in General Physiology. By Prof. Lawrence J. Henderson. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xix + 397. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1928.) 23*s.* net.

The application in recent years of physical and chemical methods of investigation to the subject of physiology has yielded an enormous amount of knowledge, which is usually of so detailed and descriptive a character that its literature is rapidly becoming the despair of the student with a strictly scientific mind. It is consequently very refreshing to meet a truly philosophical contribution like the present volume.

In the problem of the determination of the elementary condition of life enunciated by Claude Bernard, morphologists have been content with a description of the characters of the single cell while biologists have conferred upon protoplasm the possession of the elementary conditions. Prof. Henderson has effected a notable advance towards a more rational solution of this problem by shifting the focus of attention from the cell to the medium bathing it—the *milieu intérieur* of Claude Bernard—and carrying the processes of generalisation and abstraction further to a single physico-chemical system in heterogeneous equilibrium as representing the elementary condition of the phenomena of life.

Established facts are analysed mathematically; the many dependent variables by subjection to nomographic treatment are brought into graphical relationship and the whole integrated by a rational synthesis.

Interest in the volume is enhanced by a study of the problems of adaptation both in health and disease.

Magician and Leech: a Study in the Beginnings of Medicine, with Special Reference to Ancient Egypt. By Warren R. Dawson. Pp. xiii + 159 + 4 plates. (London: Methuen and Co., Ltd., 1929.) 7*s.* 6*d.* net.

Mr. Dawson, although not a medical man, has devoted much time and thought to the elucidation of the medical texts of ancient Egypt, as the pages of the periodicals of various learned bodies bear witness. In this little book, while a general account of Egyptian medical knowledge and practices forms the central theme, the author's object is to show, on one hand, how closely allied was Egyptian art to primitive magical ideas, out of which indeed it had grown, and on the other hand, to how great an extent medical science was promoted by the special conditions which prevailed in Egypt. Of these, perhaps the most important was the practice of mummification, which gave the Egyptians an opportunity of acquiring an exact knowledge of human anatomy.

Mr. Dawson concludes his account with examples of the survival of Egyptian theory and drugs in later medicine. An interesting example of a persistent belief is that of the therapeutic value of mice. The eating of a skinned mouse is prescribed in a papyrus of 1400 B.C., but remains of mice have been discovered in the alimentary canals of children in predynastic graves more than six thousand years old, and they have been prescribed as a remedy for whooping-cough for children within living memory in England.

Recent Advances in Physiology. By Prof. C. Lovatt Evans. (Recent Advances Series.) Third edition. Pp. xiii + 403. (London: J. and A. Churchill, 1928.) 12*s.* 6*d.* net.

The fact that this volume has reached its third edition in three years is a good recommendation of its value. It is, in fact, an excellent introduction to advanced physiology and gives a readable account of recent work on certain aspects of the subject. The chapters have been rearranged; two have been added on excitability and chronaxie and on the nervous impulse, and three have been omitted, two on the blood and one on the work of the heart. In spite of these alterations, the number of pages is slightly greater than in the second edition. Whether the present order is the best is somewhat open to question, since the new chapter on excitability and chronaxie is the first, and this is a subject which is one of the most difficult for the novice to follow. A very good account of the work of Pavlov and his pupils on conditioned reflexes is given, and serves as a useful introduction to the English translations of this work which are now available.

The book is well up-to-date and remarkably free from errors; we note, however, in the chapter on active principles of some endocrine organs, an absence of a reference to the international standard of posterior lobe of pituitary gland, and also that the international standard of insulin is stated to contain 24 units per mgm. instead of 8, some confusion between 'rabbit' and 'clinical' units being evident. This is a readable volume and should be in the hands of all those taking an advanced course of physiology.

A History of Pathology. By Prof. Esmond R. Long. Pp. xxiv + 291 + 49 plates. (London: Baillière, Tindall and Cox, 1928.) 22*s.* 6*d.* net.

Prof. Long, who holds the chair of pathology in the University of Chicago, has given in this little volume the first definite and systematic account in English of the history of his subject. The work is divided into twelve chapters devoted respectively to the pathology of antiquity, Galen and the Middle Ages, the pathology of the Renaissance, the seventeenth century, Morgagni and the eighteenth century, pathology in France, England, Vienna, and Berlin respectively in the early part of the nineteenth century, pathological histology and the last third of the nineteenth century, the rise of bacteriology and immunology, and experimental and chemical pathology. An appendix contains a list of the classical works on the subject from Hippocrates to Cohnheim. The book, which contains a vast amount of information presented in an attractive manner, is illustrated by numerous portraits and figures from the older works on pathology.

Miscellany.

The Principles and Practice of the Dilution Method of Sewage Disposal. By Dr. W. E. Adeney. (Cambridge Public Health Series.) Pp. xii + 161. (Cambridge: At the University Press, 1928.) 12*s.* 6*d.* net.

When soluble organic matter is discharged into a river, seventy to eighty per cent undergoes complete oxidation into carbon dioxide through the agency of bacteria, the remainder for the most part being converted into humic substances as by-products of bacterial activity, and only a relatively small proportion going to build up the bacteria themselves. The ammonia formed in the process is finally oxidised by bacteria to nitrites and nitrates. If, however, there is insufficient oxygen present in the water for these changes to be completed, noxious products are produced and the ammonia remains unoxidised.

The quantity and rate at which oxygen is used during these changes is described with many examples from Dr. Adeney's own experimental results; the researches of the author and his co-workers on the rate at which waters dissolve oxygen from the atmosphere under open-air conditions are clearly presented.

It is possible to estimate the extent to which the waters of a river can deal with the sewage of a neighbouring community, having regard to the

absence of noxious decomposition products on one hand, and on the other hand, to the economical discharge of the duties of the local authority. As an example of the quantitative nature of such an estimate, the daily amount of oxygen required for the bacterial oxidation of the sewage entering New York Harbour was found experimentally, the rate at which oxygen was entering the harbour water from the atmosphere was calculated, and from these a value obtained for the oxygen content of the harbour water, which value was in good agreement with the quantities actually found.

The book includes full directions for the estimation of dissolved gases in water, and useful information concerning the interpretation of the results of some arbitrary but common methods of water analyses. It is of wider interest than the title suggests. H. W. H.

School Laboratory Fittings. By Alan E. Munby. Pp. vii + 88. (London: George Bell and Sons, Ltd., 1929.) 7*s.* 6*d.* net.

Mr. Munby is well known as an ingenious and successful architect of science laboratories, and his large book on laboratory design and equipment is generally recognised as the best work on the subject. The present book deals with a more circumscribed topic, namely, the fittings of school laboratories. A handbook of this kind, embodying the results of long and wide experience, cannot fail to prove of great assistance to educational authorities and to exercise a beneficial effect upon science teaching in the schools. As Mr. Munby truly says, the present-day cost of education calls for a high efficiency in the material requirements of teaching, and particularly in laboratories the need for intelligent planning and fitting is urgent.

A noteworthy feature of the book is that all the arrangements and fittings described have actually been put into use, in the laboratories of Clifton College and elsewhere, while the illustrations are largely based upon the author's working drawings. Attention may be directed in particular to the excellent scheme for an elementary chemical laboratory, where ample fume-cupboard accommodation is provided for a class of thirty, and the benches are so arranged that the master has complete and easy control over the whole room.

The book is well printed and excellently illustrated, and Mr. Munby must be thanked for presenting us, at a nominal price, with professional information of a high practical and financial value to all who are about to build or fit school laboratories.

Industrial Tyneside: a Social Survey made for the Bureau of Social Research for Tyneside. By Dr. Henry A. Mess. Pp. 184. (London: Ernest Benn, Ltd., 1928.) 10*s.* 6*d.* net.

In this volume the author has tried to present the facts of the social conditions of the eleven municipal areas from Newburn and Blaydon along both banks of the Tyne to the sea. Most of the information was collected in the years 1926–27, but the survey does not claim to give a complete view of the area in those particular years. The author has attempted, with much success, to indicate the forces that are at work in changing the life of Tyneside. The result is a valuable study of the evolution of human society in one of the oldest areas of industrial England. The influence of place in the growth of this human 'conurbation' is not neglected, but the study might have had wider value if the geographical factors in the rise and growth of Newcastle and other centres had been given more attention. The poorness of the maps is out of keeping with the care and trouble that the work in general has demanded.

Psychology.

The Fundamentals of Human Motivation. By Prof. Leonard T. Troland. Pp. xiv + 521. (London: Macmillan and Co., Ltd., 1928.) 21*s.* net.

Of books on general psychology as at present understood there is a goodly array. Their name is legion, and we gather that it would not have occurred to Dr. Troland to add another to the list. The problems he sets out to solve are essentially practical. Why do people behave and feel as they do? What are the foundations of impulse, desire, emotion, purpose, and habit? Yet his book does not belong to the category of 'applied psychology'. Though he is guided by practical considerations, his aim is to fill a gap in the literature of pure psychology. His treatment, which is very thorough, eventuates in a form of psychological hedonism, according to which our voluntary choices are determined by the summation of all past affections. This 'hedonism of the past', which is his interpretation of happiness, constitutes the basis of preferability among alternative courses of action.

Dr. Troland applies his principle to a large number of 'motivational processes', including those involved in such a primitive interest as sex, and such modern interests as motor-cars, music, the drama, radio, and so on. The book is not an easy one to read, for the author is not concerned to temper the wind to the shorn lamb. He helps the general reader of good education, however, by supplying a glossary of the more difficult, and, we may add, the neologistic, terms.

Introduction to Social Psychology: Mind in Society. By Dr. Radhakamal Mukerjee and Dr. Narendra Nath Sen-Gupta. Pp. xv + 304. (London and Sydney: D. C. Heath and Co., 1928.) 7*s.* 6*d.* net.

Though emanating from India, this book is in fact an American production. Not only have the authors been very largely influenced by American writings on the subject, but also they have adopted the American form of presentation. Within the limits of this class of literature, it is a careful and competent production. But the limits of usefulness of text-books of social psychology are obvious. On one hand, the foundations are in many respects anything but firm in the present state of our knowledge. On the other hand, concrete studies of the behaviour of man in society are few. Of necessity, therefore, a text-book is unsatisfactory. It

gives the impression of vague inexactness and fails to achieve the one result of value which may at present be looked for from social psychologists. They can at times throw light into dark corners and so illuminate social problems; but this they do, not by a methodical working over the whole field of social organisation, but here and there as they are enabled to relate some social activity to some psychological characteristic. The attempt to reduce the subject to the form of a science can scarcely end in anything but failure. It is presumably made to satisfy the call upon teaching institutions to include social psychology in their courses.

Industrial Psychology. Edited by Dr. Charles S. Myers. (Home University Library of Modern Knowledge.) Pp. 252. (London: Thornton Butterworth, Ltd., 1929.) 2*s.* 6*d.* net.

THE subject with which this book deals is comparatively new as a definite department of scientific investigation, but already it is far enough advanced to justify recognition in the Home University Library. Most of the chapters have been contributed by members of the staff of the National Institute of Industrial Psychology. Dr. C. S. Myers, the well-known Director of the Institute, provides an introduction in which he explains the scope of industrial psychology, and its relations to general, and to other branches of applied, psychology.

The topics dealt with by the several contributors include the relations of work to environment and to rest, unproductive working time, industrial accidents, the measurement of intelligence, fitting the man to the job, and the economic aspects of industrial psychology. The book represents work done by competent psychologists in actual contact with industrial conditions, and it is probably the most successful attempt yet made to put the principles and methods of industrial psychology in language which any educated reader can understand. The application of scientific methods to industrial problems ought to become known, not only to industrialists, but also to everyone who is interested in social progress.

Objectives and Problems of Vocational Education. Edited by Prof. Edwin A. Lee. (McGraw-Hill Vocational Texts.) Pp. viii + 451. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 15*s.* net.

THIS book consists of seventeen articles written by "men who have been part and parcel of the movement for vocational education [in the United States] from its inception". In 1914 Congress appointed the Commission on National Aid to Vocational Education, and in 1917 the Smith Hughes Act for Vocational Education became law. From a study of the past, and more especially the immediate past, present 'ends in education' are considered with an eye to the future. Education for the professions, agriculture, commerce, home economics, industry, pass in review, and questions of vocational guidance, rehabilitation of the disabled, vocational teacher training, and the attitude of employer, worker, and parent to the present working schemes, are dealt with by experts in their subject. The result is a valuable book for those wrestling with the problem of how best to bridge the gulf between school and work. R. J. B.

Emotion and Delinquency: a Clinical Study of Five Hundred Criminals in the Making. By Dr. L. Grimberg. (Library of Educational Psychology.) Pp. ix + 147. (London: Kegan Paul and Co., Ltd., 1928.) 7*s.* 6*d.* net.

DR. GRIMBERG develops the hypothesis that the delinquent errs not so much through any great intellectual defect as through a defect of emotional balance which at bottom is based on a constitutional defect of the endocrine system. The groups of girl delinquents which he deals with consisted of (*a*) those who were of low average mentality; (*b*) those who were frankly amoral and were quite unable to adjust to their environment. In both groups it was found that economic conditions had very little to do with the delinquency. In the first group, the delinquency started after leaving what had often been a very strict home where life had not adapted them for meeting modern requirements of social conditions. In the second group, delinquency had begun at home, where conditions were usually bad, struggling and immoral.

An excellent presentation by a writer with a very wide knowledge of the maladjusted personality.

Matter and Method in Education. By Mary Sturt and Ellen C. Oakden. Pp. xiv + 345. (London: Kegan Paul and Co., Ltd., 1928.) 7*s.* 6*d.* net.

THIS book is well written and deals in an attractive way with a survey of modern educational practice. The first part raises the question of the curriculum, and emphasis is laid on the æsthetic and humanistic sides of teaching. The second part gives ample guidance in such practical needs as form of lesson, time-table, examinations, promotion, discipline. Useful comparisons are made between English and American methods. The book concludes with a discussion of the position of the teacher.

More than a passing reference is made to the educational outlook of Sanderson of Oundle, and, although primarily concerned with the elementary school, this book is of value to all interested in teaching. Its scope does not apparently admit of any lengthy discussion of the place of science in the curriculum. The writers claim that "it is an exposition of school practice and methods of to-day against their historical background". H. D. A.

Testing Intelligence and Achievement. By Dr. Albert J. Levine and Louis Marks. Pp. ix + 399. (New York: The Macmillan Co., 1928.) 8*s.* 6*d.*

A CONCISE and readable survey of the field of psychological testing is given. Intelligence tests, achievement tests, and tests of 'non-intelligence traits of personality' are dealt with in order and their practical value brought out by chapters dealing with the mental defective, the neurotic and the superior child, and ending in each case with the educational problem associated with these marked variations from the normal. R. J. B.

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Chapman and Hall, Ltd.—Dairy Farming, Fraser; Growing Tree and Small Fruits, H. B. Knapp and C. E. Auchter. *W. Heffer and Sons, Ltd.* (*Cambridge*).—Sugar Beet in the Eastern Counties, 1928, No. 2. Report No. 13 of the Farm Economics Branch, Department of Agriculture, Cambridge, C. Burgess, with some observations by G. Ll. Rogers. *Macmillan and Co., Ltd.*—Text-Book of Tropical Agriculture, Sir H. A. A. Nicholls, second edition, revised by J. H. Holland. *Oxford University Press.*—Index Londinensis. An emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns. Prepared for the Royal Horticultural Society of London by Dr. O. Stapf. In six volumes, vol. 1; Index Kewensis. An Enumeration of the Genera and Species of Flowering Plants from the time of Linnaeus; Supplement VII. Additional References for the Years 1921–1925, Dr. A. W. Hill; Economics of Forestry, W. E. Hiley (The Oxford Manuals of Forestry. Vol. 2).

Anthropology and Archæology.

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News and Views.

Dr. F. E. Smith, Director of Scientific Research at the Admiralty since 1920, has been appointed by His Majesty the King in Council to be Secretary to the Committee of the Privy Council for Scientific and Industrial Research, with effect from Oct. 1, in succession to Mr. H. T. Tizard, who recently resigned upon his appointment as Rector of the Imperial College of Science and Technology. Before Dr. Smith went to the Admiralty he was superintendent of the Electrical Department, National Physical Laboratory, for nine years, and his work on the development of electrical standards and related subjects was of the highest scientific and practical importance. It was largely in recognition of this work that he was awarded the Duddell Medal of the Physical Society in 1927. Dr. Smith's particular genius is, indeed, in the field of scientific instruments, and while he has been at the Admiralty he has brought physical apparatus used in various departments of the naval service to a high state of perfection. We cannot help regretting that the Admiralty will lose such an original and ingenious experimenter, for Dr. Smith's duties will, in future, be chiefly administrative, and therefore very different from those which he has carried out to national advantage for the past nine years. We are sure, however, that he will be equally successful as an administrator, for he has been one of the honorary secretaries of the British Association since 1922 and has great organising ability. He was chiefly responsible for raising the subsidy required for the recent South Africa meeting of the Association, and at every stage of the meeting his work and efficient organisation earned high tributes of praise from all the members. He is sure to make his influence felt in the Department of Scientific and Industrial Research, but it will be difficult to replace him at the Admiralty.

The first of the series of television broadcasts conducted by the Baird Television Development Co. through the 2LO stations took place between 11 and 11.30 a.m. on Sept. 30. Both the speech and television signals originated from the Baird television studio in Long Acre. Only one wave-length was available, so speech and television had to be transmitted alternately. Television and sound receivers were installed at Savoy Hill, at the General Post Office, at the Radio Exhibition at Olympia, at the Baird Laboratory, and at Mr. Baird's private residence on Boxhill. These are the only sets which have been manufactured under the supervision of the Baird Co., but in addition it is estimated that about twenty television sets made by enthusiastic amateurs from instructions published in *Television* were in operation. Representatives of the Press were able to form their impressions of this first public demonstration either at Long Acre or Boxhill. There was a slight technical hitch at first, a negative instead of a positive image being transmitted, but this was quickly put right and the images were afterwards clearly received. Sir Ambrose Fleming was the first to be transmitted, followed by Prof. Andrade and Major Church. Sir Ambrose Fleming paid a tribute to the pioneer work of Mr. Baird and briefly outlined the possible developments of television. The speeches of those televised and a message from Mr. William Graham, President of the Board of Trade, in which he welcomed the introduction of television as a new development of the radio industry calculated to have a marked effect on the employment of skilled craftsmen and scientific technicians, and congratulating Mr. Baird on the success which had attended his efforts to establish television as a British industry, were received on ordinary wireless sets. Further demonstrations are being given daily between 11 and 11.30 a.m.

Proposals for the organised development of the resources of the British Empire were made by Sir Robert Hadfield in a speech delivered at the annual meeting of Messrs. Hadfield, Ltd., last spring, and have since been published in the *Empire Mail* for June. The scheme is being discussed at the autumn meeting in Edinburgh on Oct. 2–4 of the Association of British Chambers of Commerce. Sir Robert Hadfield contrasts the crowded population and shortage of work in Great Britain with the scanty population and undeveloped resources of vast areas of the Empire. The Empire was thoroughly organised for war, but he sees a lack of co-ordination and foresight in the plans for development in time of peace. He maintains that the first practical step in banishing unemployment and trade depression would be to take stock of the Empire resources and opportunities and its needs for capital and labour. This has hitherto been done only in a piecemeal fashion and there has been a lack of co-ordination between the home country and the various parts of the Empire. Many opportunities of Empire development are thus lost, and neither capital nor labour are directed into the most useful channels. Sir Robert Hadfield regards the various Imperial conferences as too restricted in outlook, being interested mainly in Empire policy, defence, and administration. The Imperial Economic Conference has helped to develop trade facilities and communications, but was too little concerned with the development of fresh resources.

Sir Robert Hadfield proposes the immediate formation of an Empire Development Board representative of all parts of the Empire, with a permanent organisation and personnel in each country. The sessions should be frequent and should be held in Great Britain and the various dominions and principal colonies in rotation, so that every member might have first-hand conditions of the requirements and possibilities of different parts of the Empire. It is suggested that the time of service of each member should be limited in order to ensure a continual fresh outlook. The affairs of the Board would involve problems of transport; new industries, hydro-electric power plant, the control of forestry, etc. Means would have to be taken to raise an adequate Empire development fund, to which all parts of the Empire would make contributions. Sir Robert Hadfield lays great stress on the scheme being a federal one,

in which co-operation and not dictation must be the guiding principle. He rightly insists that every part of the Empire would stand to gain. There is no suggestion that Great Britain alone would benefit or should in any way domineer over or exploit the oversea parts of the Empire. It is important that, as he proposes, the Empire Development Board should be kept free from the machinery of party politics.

MEMBERS of the British Association visiting South Africa this year who were interested in the archæology of the sub-continent would be grateful to the Trustees of the South African Museum for the opportune publication of the monograph on "The Stone Age Culture of South Africa", which was issued as Vol. 27 of the *Annals* of that institution just before the meeting took place. This publication, which may be regarded as the most important which has yet appeared on the Stone Age in South Africa, has been written by Mr. C. van Riet Lowe and Mr. A. J. H. Goodwin, the geologist, in collaboration. Some of the results of Mr. Lowe's investigations in the Vaal River Valley as reported to the Anthropological Section at Johannesburg were summarised in a recent issue of NATURE (Sept. 14, p. 413), and from this their importance may be gauged. The problems of the Stone Age in South Africa are many and complex. Those of grouping and typology have been boldly attacked and some considerable progress has been made, not indeed towards finality, but at any rate to such an agreed system as will afford a basis for a very real and rapid advance in the study of the implements themselves. The geological problems, upon which the prehistoric chronology depends and by which the sequence of types in time is to be determined, have hitherto been obscure. On both these sides of the investigation the progress of the last three or four years has been revolutionary. For this we are greatly indebted to the authors of this monograph, which sums up their work. It will be a standard work of reference for years to come.

THE reports that appeared in the Press during the last few days of September of an exceptionally severe hurricane in the Bahamas were not sufficiently precise to indicate exactly what path the storm followed. This want of precise information was apparently due in part to the interruption of communications caused by the storm itself, which is said to have caused more damage in Nassau than has any other visitation of a like kind so far back as records are available. The mean path of September storms passes directly across a part of the West Indies, and the fact that this particular storm appears to have joined the normal path near the southern extremity of Florida without passing over any part of the West Indies was taken to indicate that it was moving in an abnormal manner. Statistics in regard to the frequency of West Indian hurricanes in different months show that 70 per cent have occurred before the beginning of October, and that in forty-four years forty-five have occurred in October and only four in November; consequently, granted an average year, the worst should be over by now. Against the comfort to be derived from these statistics should be set, however, the possibility that the abnormal extension this year of summer warmth into autumn on both sides of the Atlantic may disturb the normal expectation and prolong the cyclone season beyond its usual span.

ON Sunday, Sept. 22, Sir J. S. Allen, M.P., unveiled a memorial plaque in the new Westminster Cathedral at Vancouver to the memory of Captain Cook. The plaque was given by the Royal Empire Society and the inscription reads as follows:

"To Commemorate the Life and Work of
the intrepid explorer of the Pacific
JAMES COOK
(1728–1779)
Captain in the Royal Navy.
Who prepared the way for General Wolfe
to Quebec
and in the month of March 1778
First revealed the wealth of this Province."

Captain Cook's voyage up the west coast of North America in 1718, which took him as far as the Bering Straits, is believed to have inspired the journey made fourteen years later by Vancouver, who circumnavigated the island which now bears his name. Vancouver, it may be added, sailed with Cook twice; was made a commander in 1790 and as such was appointed to the *Discovery*. His voyage of exploration lasting four years (1791–1795) took him to Australia, New Zealand, and North America. He died in May 1798, when his work "Voyage of Discovery to the North Pacific Ocean" was nearing completion.

THE *Canberra Times* of Aug. 6 gives an account of the impressive funeral ceremony of the late Dr. W. G. Duffield, Director of the Commonwealth Solar Observatory, whose scientific work was described in our issue of Sept. 21. The site was appropriately chosen near the summit of Mt. Strombo, within view of the observatory which is indebted so largely for its inception and equipment to his personal enthusiasm and generosity, and near the spot where the giant telescope which it is hoped to provide is to be installed. The site was specially consecrated by the Bishop of Goulburn, and the funeral was attended by the Ministers of Defence and of Home Affairs, and other government officials, and by a large concourse of friends.

THE first formal meeting of the Radium Commission, under the chairmanship of Lord Lee of Fareham, was held on Sept. 27, and was devoted to a preliminary survey of the ground which has to be covered. This body, it will be remembered, was appointed, as the result of the report of a sub-committee of the Committee of Civil Research, to take charge of the radium held by the National Radium Trust (see NATURE, May 4, 1929, p. 697). Offices have now been taken for the Commission at 5 Adelphi Terrace, Strand, London, W.C.2, and Prof. S. Russ, of the Middlesex Hospital Medical School, has been appointed scientific secretary. At the recent meeting it was decided that the radium at the disposal of the Commission should be kept at the National

Physical Laboratory, which would also undertake the testing of consignments received from manufacturers. It is not expected that more than three grams will be available for distribution before the end of the present year; in addition, a four-gram 'bomb' for intensive radiation may be obtained on loan from the manufacturers, for a limited time free of charge. It has been agreed in principle that, in distributing supplies of radium, preference shall be given to centres where radium therapy will be combined with teaching and research. In order to reduce overhead charges on the National Radium Fund, the Commission proposes to lend radium on terms which will recoup it for expenses incurred, apart from the purchase price.

For nearly seven years bird sanctuaries have been established in the royal parks in London and its vicinity, and the occasion of the publication of the Annual Report for 1928 (London: H.M. Stationery Office. 9*d*. net) has been taken to review the progress made. The sanctuaries have been created at small cost and without withdrawing from the public ground to which they already had access. Development has followed on very simple lines. In certain enclosures grass has been allowed to grow, unshorn by the gardener, and additional shrubs and undergrowth such as gorse and brambles have been planted to afford cover and nesting sites for the birds. Periodical thinning is carried out where necessary in order to admit light and air, nesting-boxes and nesting-material have been provided, food is supplied during hard weather, and vermin are kept down so far as practicable. The result has been excellent from the birds' point of view, and the public shows an increasing interest in the sanctuaries and their inhabitants. Appendices to the Report describe the more interesting happenings at the various sanctuaries, and give lists of breeding birds and bird visitors. It is satisfactory to record that the Report, instead of being a duplicated foolscap document, now appears in much more convenient form as a printed octavo pamphlet.

It is well known that the Large Copper butterfly (*Chrysophanus dispar*) is extinct in the British Isles, the last examples of this fine insect having disappeared from its home in the fen country about 1860. In the *Entomologists' Monthly Magazine* for September, reference is made to the work of the Committee for the Protection of British Lepidoptera. The lost British race of this butterfly very closely approaches in character the continental form *batavus* Obth. and the Committee has been instrumental in arranging an experiment of forming a colony of this Dutch race in England. A highly promising locality for the purpose was found in Wood Walton Fen, Hunts, and mainly owing to the efforts of Capt. E. B. Purefroy, a supply of the race *batavus* was liberated in the summer of 1927. The young larvæ survived the winter floods of 1927–28 and the butterflies have been seen in the summers of 1928 and 1929. During the present year, however, parasites reduced its numbers very considerably, but it is hoped that the future success of the colony is assured. It is noteworthy that the 'Berlin form' *rutilus* has been well established in Southern Ireland since 1914 through Capt. Purefroy's efforts. The coloured plate illustrating European races of the insect is published through the courtesy of the Entomological Society in the *Proceedings* of which (pp. 53–68; 1929) the original plate and an account of the work of the above-mentioned Committee will be found.

The expeditions fitted out by the great museums abroad are generally looked upon as scientific luxuries, but in proper hands they result in an enormous gain to the general public as well as to the scientific expert. This is well illustrated in the Annual Report of the Director of the Field Museum of Chicago for 1928. The Museum is famous for its expeditions, of which at the time of the Report thirteen were in the field, one circumnavigating the Pacific Ocean, one in eastern China, others in Europe, Mesopotamia, Abyssinia, Arabia, and various parts of America. A glance at the completed work of the year within the walls of the Museum shows how well the expeditions are made to subserve the exhibition side of the Museum's activities. The most important of the year's natural history exhibits were habitat groups of Marco Polo's sheep, of Himalayan ibex, and of the rare mountain nyala of Abyssinia, the last group including no less than five individuals; and in each case the specimens were collected by a Field expedition.

Turn to the development programme of the Field Museum and the same utilisation of expedition results is in strong evidence. During 1928 there were completed and opened to the public six large new exhibition halls in the Department of Anthropology. They represent a floor area of 58,000 square feet. The new collections shown there illustrate the ethnology of Africa and Madagascar, the latter probably the world's finest collection of its kind, and this fine spectacle the public owes to the labours of the Captain Marshall Field Anthropological Expedition to Madagascar in 1926–27. So with the other enlarged and reinstalled collections representing the ethnology of the Melanesian regions, India, Siberia, and Korea, and Egyptian archæology. For the funds to carry out these expeditions, and for many gifts in kind besides, the Museum is indebted to the public spirit of the American people. It is a noteworthy achievement, which the great museums in Britain cannot but admire and envy. That the American public appreciates the good work being done on its behalf is shown by the fact that for the second year in succession the annual attendance of visitors has exceeded a million.

The essential requirements of photomicrographic apparatus for metallurgical work were discussed in an article in Nature of Oct. 8, 1927, p. 516, and attention was directed to several mechanical details in British-made apparatus in which improvement might be effected. Afterwards, Sir Robert Hadfield, on behalf of Messrs. Hadfields, Ltd., invited British manufacturers to supply an apparatus which would fulfil the specified requirements. This invitation was accepted by Messrs. R. and J. Beck, Ltd., who successfully made a specially designed instrument embodying not only the suggested improvements but

also several novel features. It is now catalogued as the Beck Hadfield Metallurgical Microscope, and we are glad to learn that instruments of this type have already been supplied by Messrs. Beck to various firms. Devices incorporated in the apparatus with the view of ease in manipulation include means for instantly transferring the image from the visual observation ocular into the camera; for observing and focusing the image on a ground glass screen at the back of the camera or, alternatively, on a second ground glass screen at the side; and for the rapid adaptation of the apparatus for macro-photographic work. A new method of illumination is adopted in which all the parts of the system are fixed, except the lamp, which may have to be adjusted if the bulb is replaced, any form of exceptional illumination being made by means of special diaphragms. Since the illuminating train cannot move out of adjustment, the instrument is always ready for the most exacting work. A complete description of the apparatus may be obtained from Messrs. R. and J. Beck, Ltd., 69 Mortimer Street, London, W.1.

AFTER a long period of development, electric trolley vehicles have proved that in certain cases they are preferable to other forms of road transport. Several tramway undertakings are adopting them either to replace their trams or as an auxiliary to them. We learn from the *English Electric Journal* for September that Bradford Corporation has been one of the most enterprising authorities in exploring possible uses for railless vehicles. Some of these weigh eight tons and have seating accommodation for 26 passengers in the lower saloon and 30 in the upper saloon. The power equipment consists of a twin 80 horse-power motor having two armatures arranged to operate with series-parallel connexions. Thus they have the same flexibility, and enable the same economies to be effected as in a series-parallel tramcar equipment. Both of the back axles of the six-wheel buses are driven by the motor. The design is very robust and inspection is easy; the cost of maintenance, therefore, is low. Connexion is made to the trolley wires by double trolleys which have a range of 16 feet on both sides of the vehicle centre line. Three brakes are provided, namely, a foot-operated electric brake with four notches, an air brake operating independently on brake drums attached to each of the six wheels, and a hand brake working on the four rear wheels. This form of road transport will probably become popular. It is as well sprung as a petrol bus and as comfortably fitted. Owing to the absence of gears it runs more smoothly and with less noise. This is particularly noticeable on gradients, owing to the steady rate at which the acceleration can be increased. Trolley buses also provide a steady load for the supply station, and so would lead to the reduction in the cost of electric power for all purposes.

THE new headquarters of the London Underground Railways at Broadway, Westminster, is electrically heated on a novel thermal storage system. A full description of this system is given in the *Electrical Review* for Sept. 20. The electric current is taken from the company's 11,000 volt traction system, and is connected with the circuit except during the two four-hour periods when the railway load is a maximum. The heating throughout is effected by piping coils through which water is kept circulating, and embedded in the concrete of the building. The water is heated in cylinders by means of immersion heaters the temperature of which varies from 130° F. to 300° F. As the water is supplied from tanks on the twelfth floor of the building at a pressure of 70 lb. per square inch, and the upper temperature limit is the boiling point. The heat is controlled automatically. So long as the temperature of the flowing water is greater than 130° F., no water is admitted from the storage cylinders, but at lower temperatures water is admitted. Three storage cylinders are used in normal working, one being kept in reserve. Each cylinder takes a load of 336 kilowatts. The whole of the storage system is 'lagged' with three-inch cork insulation. It is calculated that if the system was left from mid-day on Saturday until Monday morning filled with water at 300° F. and with the circulating system shut down, the temperature of the water would only fall by about two or three degrees. The water is obtained from two artesian wells, 500 feet deep, and is taken from the basement tanks to the roof tanks by electrically operated Sulzer pumps. These motors and pumps are controlled automatically by switches operated by floats in the roof tanks.

EARLY in the days of the application of X-rays in the field of medicine, the harmful and serious effects upon patients and operators who had exposed themselves too freely to the rays showed that they exerted a profound influence upon the organism and the cell. It was only two years ago, however, that Muller's announcement of the transmutation of the gene indicated how fundamental the influence of the rays might be. His discovery led to intense activity in a new field of research. Muller's results have been amply verified, and new ways of using X-rays to facilitate genetic research, through altering and rearranging chromosomes as well as genes, have been discovered. So suggestive and far-reaching are the results already attained that the June number of *The Journal of Heredity*, enlarged to 64 pages, has been devoted entirely to the theme. Authoritative accounts dealing with both the botanical side (on species of the genus *Nicotiana*) and the zoological side (*Drosophila* and the parasitic wasp *Habrobracon*) indicate the effects upon general growth and the more delicate interferences with cell structures. It is impossible to deal here with all the results, but, in short, it may be stated that in plants and animals two types of genetic modification take place—an aberrant distribution of chromosomes, and hence new combinations of characters, and actual mutations in genes.

IT has often been pointed out that the development of speedy and heavy traffic on main highways has been responsible for an increasing slaughter of wild creatures. Miss Jean M. Linsdale, however, points out, in the July issue of *The Condor*, that this is but one, and not the most important, influence of roadways on bird life. The undergrowth of road-sides and their

hedges afford abundance of nesting sites, telephone wires make much used perches and lines of observation, and the road surfaces supply the luxuries of dust- and water-baths. She might have added that roads have been instrumental in increasing the range of various creatures, which have followed the trail of scattered food or found a bridge a means of crossing an impassable river. On the whole, roadways and their adjuncts have probably been more potent for the increase than for the diminution of animal life.

SIR HUBERT WILKINS was to leave New York for Montevideo last week on his way to Deception Island to resume his flights in the Antarctic region. The *Times* says he will be accompanied by Mr. O. Porter, the mechanic who was previously with him in his Arctic and Antarctic flights, and two airmen, Messrs. P. Cramer and A. Cheeseman, who have had experience of Arctic flying. The two Lockheed Vega aeroplanes they are taking with them are those used in last year's expedition. Sir Hubert Wilkins proposes to make an advanced base at Margaret Bay in Hearst Land in Lat. 66° 7′ S., Long. 66° W. A small vessel lent by the British Colonial Service will transport stores and equipment. From this base a flight will be made to the Bay of Whales in the Ross Sea, where Commander R. E. Byrd has the base of his expedition. This flight, if successful, should reveal a long stretch of the unknown coast line of Antarctica. If no suitable site for a base can be found on Hearst Land, the longer flight from Deception Island to the Ross Sea, a distance of 2300 miles, will be attempted. One of the aeroplanes of the expedition will carry a radio transmitting set with a radius of 400 miles. The bases at Deception Island and Margaret Bay will have transmitting and receiving sets.

FROM a *Daily Science News Bulletin* issued by Science Service, Washington, D.C., we learn that a new bird refuge has been established on a group of islands off the tip of Florida by executive order of President Hoover. The group consists of Snake Key, North Key, and Dead Man or Bird Key. It will be known as the Cedar Keys bird refuge, and will be administered by the Biological Survey of the U.S. Department of Agriculture.

THE Annual Report of the National Physical Laboratory for 1928 has been divided into eight parts, each dealing with a particular department, and each part may now be purchased separately, at a price which averages 1*s.* 6*d.* A part of general interest is that on the units and standards employed at the Laboratory, containing 20 pages and costing 1*s.* It gives clear and precise definitions of the standards of length, mass, capacity, density, time, barometric pressure, temperature, radium, X-ray intensity, electrical units, and candle power of light sources. It will be a great help to those concerned with measurements to be able to turn to this authoritative pamphlet on the subject.

ASLIB. Information is the title of the new quarterly bulletin of the Association of Special Libraries and Information Bureaux. It is designed to keep members of the Association in touch with the work of the Council and with one another, for experience has shown that an annual conference is insufficient to keep together an Association unless it is supplemented by reports of progress issued at short intervals. The present number contains a useful summary of papers read at the recent Cambridge Conference. It will be interesting to see what form subsequent numbers take. *ASLIB.* includes representatives of applied science, education, and the humanities, and it will tax the ingenuity of the editor of the bulletin to find material which will be of general appeal to its members.

WE are asked to announce that Messrs. C. F. Casella and Co., Ltd., scientific instrument makers and mechanical engineers, have removed to new and larger premises at Regent House, Southampton Street, Fitzroy Square, London, W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A teacher for mechanical and electrical engineering in the Day Technical school of Kenrick Technical College—The Director of Education, Education Offices, West Bromwich (Oct. 15). Assistant inspectors under the Ministry of Agriculture and Fisheries in connexion with agricultural, dairying, and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Oct. 21). A Bosch professor of bacteriology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (Nov. 9). A professor of economics in the University of Tasmania — The Agent-General for Tasmania, Australia House, Strand, W.C.2 (Dec. 1). A professor of psychology (theoretical and practical) and a professor of the theory of teaching, under the Egyptian Ministry of Education—The Under-Secretary of State, Ministry of Education, Cairo. A full-time lecturer in mathematics at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A handicraft teacher (wood and metal work) under the Warwickshire Education Committee—The Director of Education, County Education Office, Warwick. An assistant teacher of arts and crafts at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. Nautical examiners under the Aeronautical Inspection Directorate of the Air Ministry — The Secretary, Air Ministry (I.G.), Kingsway, W.C.2. A laboratory assistant under the Government of Tanganyika Territory for the Soil Chemistry Laboratories in the Agricultural Research Station at Amani — The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1797). A junior assistant under the directorate of explosives research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A director of the Imperial Institute of Veterinary Research, Muktesar, India—The Under-Secretary of State, Services and General Department, India Office, Whitehall, S.W.1. A post-graduate research student at the Cardiff City Mental Hospital—The Medical Superintendent, Cardiff City Mental Hospital, Whitchurch, near Cardiff.

Research Items.

A Fijian Game in Assam.—In *Man* for September, Mr. J. H. Hutton refers to what has been called the 'national game' of Fiji, a sport called *Veitingga*, played with a reed, on specially prepared throwing grounds, where the reed is thrown so as to strike the ground and then spring upwards towards the mark. He records the occurrence in Assam of a similar game, now noted for the first time in further Asia. The game is played by the Dzunokehena group of the Angami. Here also it is played on a prepared ground. The reed is propelled under-arm, running, and distance in a straight line is the test of skill. A variant is played with a stick, instead of a reed, thrown over-arm so as to strike hard on the ground. This form is played on the Parapit River in South America. It is to be noted that a game played with flat round beans also appears both in Assam and the Pacific, the Assamese name for the bean being *alau*, and the Fijian *Walai*. In Samoa, discs of coconut shell are used. Its occurrence in the Philippine Islands affords a link between its distribution in the Pacific and the continent of Asia, where it prevails throughout Burma and the Assam hills south of the Brahmaputra.

The Thadou Kukis.—Mr. William Shaw, of the Assam Civil Service, has published a report on the Kukis, in particular on the Shitlha clan, in the *Journal and Proceedings of the Asiatic Society of Bengal*, N.S., vol. 24, No. 1, to which Mr. J. H. Hutton contributes an introduction and notes. Mr. Hutton points out that since the suppression of the Kuki rebellion an era of closer administration has set in and missionary work has been extended, with the result that tribal sanctions and organisation have been weakened. The result is a great deal of dislocation, litigation, and general friction, as well as a diminution of general prosperity. Mr. Shaw's account therefore describes a state of transition differing considerably from conditions of a few years ago. The Thado are a scattered hill tribe of which the total numbers probably amount to about 50,000. The Kuki race, of which they form part, is obviously of northern origin and no doubt closely related to the Kachin; but they have absorbed many alien elements, including Shan, Mon-Kmer, and Negrito. Many of their customs are suggestive of the Khasis and Aos, both of Indonesian affinity. Points of Kuki culture are suggestive of the culture of the pagan Malays of the Indian Archipelago and the Philippines; for example, the Thado custom of burying the dead in what must be a troublesome excavation leading out of a simple pit grave reappears in Sumatra and in the Philippine Islands, where the Tingusan and Mandaya who follow it, also share with the Lushei and probably some tribes of Borneo the custom of eating part of the liver of a slain foe. All Kukis, including the Thado, are slave hunters. On the other side, a connexion with India is seen in the custom among old and old-fashioned men, who when performing ceremonies to propitiate any spirit, use an action to express their reverence which consists in placing the palms of their hands together and raising them in front of the face with the thumbs to the forehead. This custom may be compared with such uses as the word *taima* for the number 10,000, that is, a lakh, and the practice of singeing a tiger's whiskers.

The Earliest Exhibition of Reflex Activity.—The association of definite reflex actions with the development of the myelinisation of the central nervous system has been followed in fœtal and young kittens by Orthello R. Langworthy (Carnegie Instit., *Contributions to Embryology*, vol. 20, No. 114, 1929). In the youngest animals studied there were medullated fibres in the spinal cord, and the functioning of the myelinated reflex arcs might well explain the reflex activity of the animal. Pathways appear to become myelinated in the order in which they developed phylogenetically. As regards the correlation of reflex activity with medullation, bilateral movements of the extremities begin to co-ordinate when the ventral commissural fibres of the cord receive their myelin sheath. The animals turn the body at a time when the myelinated vestibular fibres reach the spinal cord. The hind-leg movements become better co-ordinated when myelinisation becomes more marked in the lumbar portions of the cord.

Factors in Plumage Coloration.—Experiments have been carried out by Drs. A. W. Greenwood and J. S. S. Blyth to test the influence of thyroid and gonad upon the coloration of the plumage of brown Leghorn fowls (*Proc. Roy. Soc. Edinburgh*, vol. 49, p. 313). Deficiency of thyroid results in decrease of melanin and increase of red pigment, associated with an increase in the amount of fringing due to lack of barbule formation. A surplus amount of thyroid produces opposite results. In the first case the female pattern tends to disappear; in the second it shows practically no modification. The authors suggest that the plumage typical of the male is developed independently of the gonad and depends upon a high level of thyroid functioning, whereas in the female both gonad and thyroid play a part, the former stimulating the latter, so that the appearance of a hyperthyroid effect is produced. The fact that chicks of both sexes possess a female type of plumage does not invalidate the theory, since the chick plumage may be looked upon as developing under the influence of the yolk in its own yolk sac, and there is evidence that yolk may have a modifying effect on plumage similar to that of the ovary itself.

Norwegian Herring.—State departments administering fisheries are, periodically, by reason of public agitation, faced with the difficult task of deciding whether or not it is in the best interests of the State to revise existing laws governing some part of its fishing operations. More than once, precise knowledge of the life history of the fish concerned has provided legislators with conclusive evidence upon which to base their policy of action. In Norway, just such a situation arose regarding the fishery for young herrings. A most able review of the results of current scientific investigations as applied to the contentious questions raised has recently been published by Dr. Einar Lea in the *Journal of the International Council for the Exploration of the Sea*, vol. 4, No. 1, Copenhagen, 1929. Lea's illustrated outline of the life-cycle of the Norwegian herring brings to notice an 'oceanic stage', adopted in the third or fourth year of life and extending over one, two, or three years according to the individual. During this stage the fish develops towards first maturity. Each year, those individuals which will be ready to spawn in the coming spring separate from the rest, and in the fullness of time arrive on the spawning grounds as recruit-spawners. These new facts are, as Lea shows, of immediate and indispensable value in the legislative considerations concerning the inshore fisheries for young herrings.

Plaice in Danish Waters.—In *Report of the Danish Biological Station*, vol. 34 (1928), three papers deal with the life history of the plaice in Danish waters. Dr. Blegvad, discussing the possible causes contributing to a decrease in the quantity of plaice-

food during the years 1924–27, makes the suggestion that this was due to the enormous increase in numbers of the blenny *Zoarces* and gobies during these years, their consumption of food keeping down the quantity available to plaice. Dr. Johansen writes concerning the annual transplantation of plaice in the Limfjord. Each year since 1908, with the exception of two war years, 1917 and 1918, from one to three millions of plaice have been transplanted, the costs of transplantation being borne almost entirely by the State. A disquieting fact concerning the yield from the annual planting is that there has been a marked falling off in recent years. Thus, while during the period 1899–1907 only 35 per cent of the fish planted were lost before being captured as marketable fish, the corresponding loss during 1918–27 had risen to 73 per cent. Marking experiments have shown that a very large percentage of the fish planted are caught shortly after liberation. A third paper, by Dr. A. J. C. Jensen, deals with the relation between the size of the plaice-stock and the quantity of 'first class plaice food' in certain parts of the Limfjord.

Insecticidal Constituents of Pyrethrum.—In the *Journal of Agricultural Science*, vol. 19, part 2, April 1929, Messrs. F. Tattersfield, R. P. Hobson, and C. T. Gimingham describe the isolation of the toxic constituents of pyrethrum. The method adopted was that of Staudinger and Ruzicka, who named the constituents pyrethrin I. and pyrethrin II. It is evident from the data given by Dr. Tattersfield and his co-workers, that pyrethrin I. is, to certain insects, the most highly toxic contact poison at present known. The important fact emerges from these researches that the insecticidal properties of pyrethrum are almost entirely due to this constituent. When tested on the bean aphis (*Aphis rumicis*), it was found to be about ten times as toxic as pyrethrin II. Two micro-analytical methods of determining the pyrethrin content of the flower-heads are described, and the results obtained for a series of pyrethrum samples agreed with their observed insecticidal properties to the aphis mentioned. Pyrethrum, in being comparatively harmless to man, has advantages over most potent insecticides. Its application is, however, circumscribed owing to the fact that certain insects are very resistant to it, and to the supposed readiness with which its toxicity is lost. The authors are of opinion that its use could be extended, and suggest that this might be facilitated if the content of pyrethrin I. could be increased by selective plant breeding.

A Rare Fossil Marsupial.—In 1921 a new genus, *Euryzygoma*, was created by Heber A. Longman for a fossil marsupial characterised by the peculiar development of the zygomatic arches. At the time a writer in NATURE (May 19, 1921, p. 372) doubted the advisability of separating this form generically from *Nototherium*, but fresh material has now turned up from the original locality, Brigalow, Darling Downs, Queensland, and in the fragments, which compose about half a cranium of an individual much younger than the type specimen, Longman finds those peculiar developments of the zygoma which were so marked in the adult (*Mem. Queensland Mus.*, vol. 9, June 1929, p. 247). He concludes that the characters are distinctive and of generic value, and that *Euryzygoma dunense* is an extremely specialised member of the *Nototherium* group, exemplifying the evolution of a bizarre type. The suggestion is repeated, and is supported by reference to analogous structures in other extinct mammals, that the prolongation of the inferior lateral processes of the anterior part of the zygoma may have been associated with the presence of 'cheek pouches'.

Locomotion of Urocoptid Snails.—Snails of the family Urocoptidæ, as studied by Henry A. Pilsbry in the West Indies, exhibit a peculiar mode of locomotion (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 81, 1929, p. 449). The muscular waves which pass along the foot are rather rapid in movement, are narrowly localised, and raise the sole clear of the surface upon which the snail crawls, in such a way that the edges of the raised fold are kept in contact and the wave appears as a fine straight line across the sole. In some species only one wave is in progress at a time. The result of this deep and compressed wave is that no portion of the foot *slides* upon the substratum, as happens in the case of ordinary snails. The author regards this as an adaptation to movement upon the minutely roughened and slightly porous surfaces of limestone rocks and cliffs, to which moist bodies tend to adhere. Species of other families on these cliffs, which did not possess the adaptive wave, differed from the Urocoptids in moving slowly and in exuding copious slime which lubricated the track.

Defective Graft Unions in Apple and Pear.—The failure of some types of apple and pear to unite with the stock when grafted on to other types, has led to the practical recognition of 'uncongeniality' between such types, although in most cases the grafting operations may be quite successful. After studying microscopically a number of 'congenial' and 'uncongenial' grafts, F. C. Bradford and B. G. Sitton (*Bull. Mich. Agric. Expt. Stat.*, **99**, p. 106; 1929) conclude that the failure of uncongenial unions is due to the inability of the cambia of scion and stock to unite, particularly on the outside, where contact between the phloem tissues should be effected. A certain amount of union on the xylem side of the cambium is common, but this tends to break down and ultimately to fail. The breaking down appears to be seasonal as it occurs after the period of maximum cambium activity. Uncongeniality appears, however, to be quite independent of the differences in duration and time of cambial activity of stock and scion. Rather it appears to result from chemical differences between the uncongenial tissues, because a marked feature of the transitional areas at the junctions is the presence of deposits or precipitates inside many of the cells. A further factor of great importance is that the stock apparently receives little or no organic food from the scion, presumably owing to lack of phloem connexions. Hence, if the stock is without leafy branches of its own, it will die. On the other hand, if the stock has independent leaves, the grafted branch may persist for some time and even bear fruit, in the same way as a ringed branch may do.

Niagara Falls.—Erosion and water diversion for power purposes have had a serious effect on the Horseshoe Falls at Niagara. Recession is said to average 3·7 feet a year on Canadian or Horseshoe Fall. This, together with the diminished flow, has left bare the flanks of the Canadian falls and thinned out the flow over the American falls to such an extent as to impair the scenic beauty of the falls as a whole. After two years' study of the problems involved, the International Niagara Board issued a report and suggested remedial measures which are now to be put in hand. It is believed that it will be possible to distribute the water so as to cover the bared flanks of the Canadian falls and to check the present rate of erosion. The remedial works are to be built under conditions that will admit of their being tested in the course of construction and adjusted in plan if necessary. Experiments are to be made on the effect of diversion of further quantities of water from the falls. From October to March for seven years, an additional

10,000 cubic feet per second will be diverted on each side of the river and the effect on the scenic beauty of the falls noted.

Atmospheric Ozone.—The September issue of the *Proceedings of the Royal Society* contains a note by Drs. Götz and Dobson on the ozone content of the atmosphere above the Arosa Observatory. They have now established the important result that the average height of the ozone in the air is not lower when there is much present than when there is little, but that, if anything, the reverse is more nearly true. There is also some indication that the height is greater in spring than at other times of the year, but this is not yet certain. The observations have been discontinued temporarily until more suitable instruments than those at present available have been obtained for making exposures when the sun is low, as this cannot be done at present when it is less than 14° above the horizon.

Diffraction of Cathode Rays.—A further paper on the diffraction of cathode rays has been published by Prof. G. P. Thomson in the September number of the *Proceedings of the Royal Society*. As in his earlier work, he has employed for gratings the irregularly orientated micro-crystals of extremely thin metallic foils, but in this new work he has prepared the foils by cathodic sputtering on to a base of celluloid acetate or of rock-salt, which is afterwards removed by solution, instead of preparing them by thinning beaten leaf chemically. Prof. Thomson has been unable to produce diffraction rings with the slow electrons (180-300 volts) employed by Dr. Rupp, but one practically new line which is being developed by him is likely to prove very important; by photometric measurements of the diffraction rings a curve can be deduced giving the variation of wave-scattering with angle for the *individual atoms*, and the results which he has already obtained indicate that the mean position of the scattering material is nearer the centre of the atom for X-rays than it is for electrons.

Reaction on a Platinum Surface.—In some experiments on the union of hydrogen and oxygen in contact with a heated platinum wire which are described by Donnelly and Hinshelwood in the August number of the *Journal of the Chemical Society*, it was found that the reaction follows a different law at normal pressure from that reported by Langmuir at low pressures. This may be due to the adsorption taking place in layers more than one molecule thick, but more probably to the presence of more active portions on the metal surface, when at higher pressures the less active centres, being now predominant, will change the velocity results completely. The experiments support the second theory, and it is suggested that if the reaction velocity law changes with pressure the presence of such centres of varying activity may be inferred. It is clear from these (and other) results that the simple Langmuir hypothesis of unimolecular adsorption layers in catalysis on surfaces is not always adequate and should not be extended into regions of pressure higher than those used by that investigator without further experiments on the influence of pressure on the course of the reaction.

Effect of Intensive Drying on Chemical Changes.—Many recent experiments on the effect of intensive and prolonged drying on the properties of reactive systems have given contradictory results. In the August number of the *Journal of the Chemical Society*, Prof. H. B. Baker and Prof. W. A. Bone contribute papers in which they make it clear that the utmost care in cleaning and preparing the apparatus is absolutely essential to obtain satisfactory results. Many of the recent experiments have clearly been done without sufficient attention to these details, and it is to be hoped that, in future, workers in this field will realise what is required and that the hasty publication of conflicting results will, in consequence, be minimised. As an example of the care necessary, it may be mentioned that pyrex glass is unsuitable for such work if it has been sealed off in contact with hydrogen, since water is introduced into the system by such procedure. Again, it is mentioned that in the preparation of an inert mixture of hydrogen and oxygen by drying the mixed gas from the electrolysis of baryta, it is necessary that the baryta should have been recrystallised fifteen times, with all imaginable precautions, before the gases were obtained in a state of sufficient purity; when the necessary precautions were taken the experiments were repeated with complete success by Prof. Bone. Drying by heating in a current of purified air is also more effective than baking in an electric oven, since invisible particles of dust can then be burnt up. The necessity for using purified phosphorus pentoxide, neglect of which caused earlier failures with older workers, now seems to have been realised.

Theory of Oxidation and Reduction.—The theory which regards oxidation as due to loss and reduction to gain of electrons requires some modification in the light of newer theories of valency, in which what are called covalent bonds are supposed to be due to sharing rather than to transfer of electrons. In the August number of the *Journal of the American Chemical Society*, Prof. W. A. Noyes has given a careful and suggestive discussion of the way in which oxidation may occur, and he distinguishes three types of oxidation: (1) Transfer of an electron; (2) oxidation by positive hydroxyl: a molecule of hydrogen peroxide is assumed to be separable into two oppositely charged OH groups, the positive one of which can add itself to a lone pair of electrons, oxidising a neutral atom to an ion; (3) oxidation by semi-polar oxygen atoms, in which an electrically neutral oxygen atom separates from one compound with its six valency electrons and attaches itself to another molecule, as is supposed to occur in the formation of perchlorate from fused chlorate; in case (3) the oxygen may unite with a hydrogen ion and form a hydroxyl group.

Ignition of Firedamp.—A revision of an earlier paper of 1925 on the above subject, incorporating recent investigation, has been issued as the *Safety in Mines Research Board Paper* No. 53 (London: H.M. Stationery Office. Price 6*d*.). The report is by Prof. R. V. Wheeler and Dr. H. F. Coward, and must be regarded as a very valuable contribution to the literature of the subject, which is of fundamental importance in mining. It summarises existing knowledge as to the conditions under which various forms of heat application, such as compression, contact with flames, electric discharge and friction, reach the combined intensity and duration necessary to cause ignition of various inflammable mixtures of firedamp (methane) and air. Work undertaken in other countries is considered as well as that carried out in England. The general results indicate that any ordinary sustained flame will ignite all inflammable mixtures. Heated surfaces are relatively less dangerous than lamp flames unless their temperature is unusually high. A body possessing a large surface is more dangerous than a wire, and a wire is more dangerous than a frictional spark of equal temperature. Electric sparks are more dangerous the more rapidly their energy is communicated, so that capacity sparks are more dangerous than inductance sparks of equal energy. The character of the supply, direct or alternating, does not materially affect the incendivity of inductance sparks. It is clear from the report that very valuable research is being actively carried out, and it is to be hoped that another report, with more new work, will soon be required.

The Thirteenth International Physiological Congress.

THESE meetings have occurred triennially with the exception of the interruption caused by the War. Since the armistice, physiologists have assembled in turn at Paris, Edinburgh, and Stockholm, but this is the first occasion on which they have congregated outside Europe. The remarkable success of this experiment has far exceeded the expectations of the most optimistic among its promoters. More than 300 registered European representatives with, in many cases, wives or husbands crossed the Atlantic; 350 of these sailed on the s.s. *Minnekahda*, thus giving Europeans an additional opportunity for that contact and exchange of ideas which constitute the chief assets of a congress. This trip, though lasting ten days, was favoured with delightful weather and filled with a variety of amusements and sporting events; yet the intellectual side was not wholly neglected, for the daily lectures ranged from "The Holy Land" by a returning American lady who had been visiting Christ's 'home town' to "The Mystery of Life" by Prof. A. V. Hill. In discussing the interpretation of the records of heat production by living and dying tissues, he pointed out the necessity of accounting for all the purely physical changes first; for example, the enhanced resting heat-rate of a stimulated muscle is satisfactorily accounted for by the effect of the resulting increase of osmotic pressure in lowering the aqueous vapour pressure of the muscle and so causing a condensation of vapour from the surrounding medium.

Great as was the success of the west-bound pre-congress, it was soon to be eclipsed by the official Congress at Boston, Mass., on Aug. 19–23, which was a triumph of organisation and hospitality. 700 foreign delegates were the guests of the 1200 members of the Federation of American Societies of Experimental Biology.

The opening lecture was delivered by Prof. August Krogh of Copenhagen, on "The Progress of Physiology". He pointed out that modern physiology was growing so unwieldy that just as the practical teaching situation had necessitated the separation of pharmacology and biochemistry as independent sciences, so it would be necessary to create separate chairs of biophysics, comparative physiology, etc. Although he regarded physiology as an independent science, yet the necessities of practical medicine have created an unbreakable link, and to derive full advantage from this intimate relation, the study of disease would be the better for physiological direction and co-ordination, since it is the functional reaction of the organism to the attack of disease and to the therapeutic measures which is, after all, the central problem. He pointed out that, although our physical problems have so far usually been rather elementary, yet the situation is rapidly changing, as shown by new discoveries like that of radiations from rapidly growing tissues.

This reference presumably referred to the observation of Gurwitsch that when the tip of one actively growing onion is brought near to the tip of another growing onion, whether end-on or broadside-on, mitosis is stimulated in the latter in the neighbourhood of the growing tip of the former; various filters were interposed to determine the range of wave-lengths to which the radiations were confined. Other experimenters have attempted to reproduce these results, but the evidence so far is insufficiently conclusive to warrant acceptance of so important a principle involving such radiating centres of activity. Borodin, using disc-like cultures of yeast as receptors, has reported enhanced budding in the immediate vicinity of the tip of a growing shoot; he, however, localises the radiations to a different range of wave-lengths. Gurwitsch also maintains that there exist centres of action outside the growing embryo. The problem requires more rigid investigation, but with the evidence so far available, a statistical analysis would probably show that the number of positive results slightly exceeds the negative. Attractive as this hypothesis of biological rays may appear, we must await further proof of their action; even if direct demonstration is not forthcoming, we may by indirect methods, such, for example, as the already attempted correlation with the glucose-lactic-acid metabolism of growing tissues, lend support to this counterpart of the fields of force encountered in the physical sciences.

The hospitality extended to the delegates was on the most lavish and generous scale imaginable. The guests of honour at the banquet presided over by Prof. Cannon were the veterans of physiology—Prof. Ivan Pavlov and Prof. Léon Fredericq—who responded in appropriate speeches. The president made some appreciatory observations on the birth of physiology in Italy, to which Prof. Filippo Bottazzi replied, and, speaking on behalf of his countrymen, invited the members to hold their next congress three years hence in Italy, where they would be assured of a hearty welcome. Following a short speech by the president tracing the rapid rise of modern physiology in England, Prof. A. V. Hill was invited to speak on behalf of British physiologists. In a notable speech he did appreciable service in cementing the bond of union between the two English-speaking nations, and reminded his hearers that Boston had arisen from a colony founded in Massachusetts by John Winthrop of Trinity College, Cambridge, almost exactly three hundred years ago. Prof. Otto Frank spoke on behalf of his German colleagues, and Prof. Gley, who is one of the finest French orators, delivered a most rousing speech. After the banquet, open-air dancing was carried on into the advancing hours of the following morning in the enchanting grounds of Harvard, delightfully illuminated by Chinese lanterns and a full moon and with sufficient warmth for the lightest of dresses.

Another memorable evening, both from the musical as well as from the spectacular view, was the occasion of the concert of the Boston Symphony Orchestra, given in the quadrangle of the new and imposing buildings of the Harvard Medical School, when the marble and granite stonework, relieved by the grass landscape, was so harmoniously illuminated both from artificial and lunar sources.

The communications and demonstrations were so numerous that five or six sections were run simultaneously for seven sessions, and the subjects dealt with covered the whole range of life from the ante-natal state to senility and death. They were mainly of a detailed character, representing only small advances but extending over a very wide front; consequently only a few of the points of interest are selected at random for mention.

Using a piezo-electric method already described in NATURE (**121**, 622; 1928), Harvey demonstrated the effect of high frequency sound waves on cells and tissues; bacteria can be broken up by high intensity sound waves and the suspension sterilised.

In discussing the mechanism of sleep, Hess brought forward experiments which led him to believe that sleep is an inhibitory state induced as a consequence of a state of excitation of certain subcortical centres; according to this, the induction of sleep is a positive

process—the promotion of restorative processes within the tissue. This view is directly opposed to the prevailing theories of sleep; Pavlov, from his interesting address on the part played by inhibition in the normal activity of the brain, thinks that sleep is the result of the spread of inhibition throughout the entire cortex and subcortical centres, and that the spread may originate from any point whatsoever.

The further chemical study of glutathione, a cellular constituent discovered by Hopkins and found to be of enormous importance in the oxidative mechanisms of living and actively growing tissues, has proceeded in several directions. Kendall, starting with a couple of tons of baker's yeast, has devised methods for increasing the yield and for estimating the glutathione by oxidation of the SH group with potassium ferricyanide; mention was also made that glutathione is a tri-peptid containing not only cysteine and glutamic acid, but glycine as well. [See, however, the letter from Sir F. Gowland Hopkins in NATURE of Sept. 21, p. 445.]

Progress was recorded in the extraction and purification of some of the hormones. Doisy has extracted from the urine of pregnant women by means either of chloroform or olive oil a product which on purification yielded a potent crystalline folliculin indistinguishable from that obtainable from follicular fluid; a paradoxical situation thus arises from the appearance of so large an amount of the œstrous hormone in the blood and urine during pregnancy, in view of the reports of abortion produced by injections of this hormone. Voronoff and his co-workers showed sections and photographs of parts of grafts of testes removed from animal and man; they describe a preliminary disorganisation followed by a re-organisation into two zones of which the peripheral zone is well vascularised and has seminiferous ducts possessing active epithelial cells.

Zavadovsky, in his investigations on the effects of hormones on the plumages of birds, found that activation or depression of pigment formation in brown leghorns by thyroid gland depended on the dose, depigmentation following large doses. He also came to the conclusion that the redistribution of the pigment in the feather of leghorns is to be regarded as a specific effect of interference of antagonistic influences of the thyroid hormone on one hand, and the feminine sex hormone on the other; his report was illustrated by dia-positives and skins of experimental animals.

Williams, McGlone, and Bazett produced evidence for the identity of certain specific receptors with definite nerve end-organs in the prepuce of man by a comparison of the distribution of cold and warm spots with histological preparations by noting the depths and making a count.

On the conclusion of the Boston Congress, the remaining foreign delegates, numbering now 750, were conveyed by motor buses via Plymouth to the Marine Biological Station at Wood's Hole on Long Island Sound. Demonstrations were arranged and many opportunities were given for observing the microtechnique developed by Chambers and his co-workers for physiological study of the contents of a single cell. Methods of collecting material were shown to small parties on short expeditions in the laboratory's yachts. The day was brought to a delightful close with the local festive event of a 'clam-bake'. These shellfish, most closely approached by our mussel, are dug out of the sand and baked with sweet potato or other vegetable on the sand.

The party reached New Haven next morning by steamer, where they had an opportunity of visiting Yale University; they were welcomed by Prof. Yandell Henderson, who showed them, amongst other things, radiograms illustrating the production of atelectasis and of pneumonia in animals and its relief in these cases as well as in man, by the administration of carbon dioxide.

The foreign delegates were entertained at New York by Columbia University during their second week; the programme included visits to the new Medical Centre, the Rockefeller Institute, and to the Marine Biological Station on Long Island, when a visit to Prof. Graham Lusk's country house was included. It may be mentioned that, under pressure from his friends and colleagues, Lusk has just issued a revised edition of his excellent treatise on nutrition.

The party divided into two main groups, the first 150 being invited to Toronto, and the second, numbering 60, to Rochester (N.Y.), while the remainder left for their homes or for the Psychological Congress. Those who visited Rochester were given an account and demonstration of the new colour process in kinematography by research workers from the Kodak Works; it is the munificence of the Eastman family which is the main support of medical research in Rochester. The colour process is based on a purely optical device: the coloured field is projected, after first passing through a glass colour filter with three parallel bands of blue, red, and green, on to a special film having corrugations in the celluloid parallel to the coloured strips in the filter; these corrugations act as fine astigmatic lenses which project three separate line pictures on the sensitive film. The film is developed in a special manner so as to give a positive picture—really three superimposed positive pictures. By projecting this film with a similar parallel placed glass filter, the image on the screen appears in colour, which, as judged from examples like a pond of water-lilies and goldfish, seems perfectly natural.

The party entertained at Toronto were shown the laboratories, including those where insulin was finally isolated and tested, as well as the annual Toronto Exhibition, the greatest of its kind in the new hemisphere. The parties met again at Montreal, where McGill University was found to be as active in hospitality as in medical research.

The smaller party left a day earlier to visit Quebec, where they were the guests of the French Canadian University. In both these towns the physiologists were accorded a welcome by the civic authorities and by the Government of the Province of Quebec.

About 200 members set sail from Montreal and Quebec on the s.s. *Doric*, having made new friendships and associations, and looking forward with pleasurable anticipation to a re-union three years hence.

The Froghopper Problem in Trinidad.

THE sugar-cane froghopper, *Monecphora* (*Tomaspis*) *saccharina* Dist., is a serious enemy of the cane growers of Trinidad, and although there are records dating back to 1862, which may possibly refer to this insect, no severe outbreak occurred until 1906. Heavy intermittent attacks have followed ever since, the most disastrous year in this respect being 1917, when about 10,000 tons of sugar were lost through froghopper damage. From 1909 onwards investigations into froghopper eradication were conducted mainly by officers of the Trinidad Board of Agriculture and by certain specialists. Up to the end of 1917 this work was purely of an entomological character, but the studies of Williams and of Nowell showed the need of

approaching the problem on a wider basis. In 1924 a Committee was constituted to inquire further into, and to report upon, the froghopper pest with the view of its control and ultimate eradication. Among other proposals it led in October 1925 to the Governor appointing a Froghopper Investigation General Committee, and the deliberations of this body are published in the form of *Minutes* and *Proceedings* at frequent intervals.[1] The first meeting of this Committee was held in November 1925, and three sub-committees were appointed to deal respectively with (1) agricultural relations ; (2) entomological relations ; and (3) soil relations. Their personnel included planters, officers of the Department of Agriculture, and members of the staff of the Imperial College of Agriculture. The reports of these sub-committees are considered by a scientific committee which submits recommendations thereon to the general investigation committee alluded to above.

Among the more interesting features recorded or discussed in these *Proceedings*, it appears that the eggs of the froghopper hatch freely only when the humidity of the atmosphere is greater than 90 per cent of saturation. Some eggs, however, exhibit delayed hatching even though the moisture conditions are entirely favourable, a fact of considerable practical importance, and the cause of these delayed hatchings is now being investigated. No reliable method of egg-destruction has been discovered, but the practice of bare-fallowing well-ploughed land is suggested as a possible measure in that it exposes the eggs to the effects of the sun. The destruction of the nymphs by means of dusting with the proprietary agent ' Cyanogas ' appears to offer considerable promise as a practicable and economic method of eradication, but no insecticidal treatment for destroying the adult insects has yet been found. The use of light traps is not considered to have been adequately explored, and, in view of some success having been obtained on certain estates, improved forms of traps are to be tested. The only other entomological measure of importance is that of biological control, and it has been decided to prosecute a vigorous campaign in the near future in order to develop this phase of the work, and with special reference to the study of egg-parasites and predators in the field.

Perhaps one of the most valuable results coming from the froghopper investigation has been its beneficial effect on general agricultural practice. Once it became to be realised that the subject is by no means exclusively entomological, increasing attention has been given to soil conditions and to the factors governing the growth of the crop in general. The fact that a fairly definite correlation exists between susceptibility of canes (especially ratoons) to froghopper attack and degree of soil acidity, has proved a great stimulus to further investigation in this direction. It has been found that (1) a positive correlation exists between the degree of saturation of the soil with lime and cane susceptibility ; (2) soils of blight-free areas are absorptively saturated by lime, or nearly so ; (3) soils of regularly blighted areas are less than 60 per cent saturated ; (4) there is no correlation between *gross* soil content of lime and susceptibility ; and (5) toxic aluminium in the soil often begins to appear when the degree of saturation falls below 60 per cent, and this may greatly increase the susceptibility to blighting.

There seems little doubt that the soils of the regions liable to froghopper attacks are lacking in combined lime (exchangeable calcium), and are therefore usually acidic in reaction. The reason why canes growing on such soils are so liable, whilst canes growing on lime-satisfied soils are resistant, to blighting, has not so far been discovered.

The subject of water relations between the soil and crop has received considerable attention. Field observations periodically recorded at three representative stations, for special ' good ' and ' bad ' plots, have demonstrated profound differences in soil moisture conditions. These differences are reflected in the fluctuations in the moisture-content of the leaves of canes growing on these plots and in the greater transpiration rate for bad-plot canes, leading to more rapid drying out at the time of day when the froghoppers feed. On the biochemical side it appears that the leaves of ' good ' canes are much better manufacturers of sugars and proteins than ' bad ' cane leaves, and that their moisture-content is less liable to fluctuation.

Many other problems of plant physiology are touched upon or discussed, and it is evident that much more experimentation, both of the laboratory and field type, is needed if the numerous suggestive indications and facts disclosed in these *Proceedings* are to be pursued to their practical issue. What is needed is a thorough fundamental ecological study of the cane-plant in relation to its full vigour and to its susceptibility to froghopper attack. It is evident from these reports that these aspects of the subject are fully appreciated, and that due attention to soil conditions and plant growth are more likely ultimately to prove of lasting value to the growers than the application of entomological methods only.

A. D. Imms.

[1] *Minutes and Proceedings of the Froghopper Investigation Committee.* Trinidad and Tobago. Parts I-XVI, 1925–1929. Government Printing Office, Trinidad.

Annual Conference of the Institut International de Bibliographie.

THE ninth Conference of the Institut International de Bibliographie was held, by kind permission of the governors and Prof. H. L. Callender, in the Imperial College of Science and Technology on Sept. 16 and 17. It was attended by representatives from many of the more important countries of Europe, including the following delegates : Prof. A. F. C. Pollard (President), Mr. Nemec (Czechoslovakia), M. Charles Sustrac (France), Dr. Hesse (Germany), Dr. S. C. Bradford (Great Britain), Mr. Andrau (Holland), Mr. Janički (Switzerland), and the General Secretaries, M. Henri La Fontaine (Belgium) and Mr. F. Donker Duyvis (Holland).

Monday was occupied with meetings of the Council and of the Commission of the Classification. Dr. Bradford gave a report on the discussions on classification during the recent congress of librarians in Italy. He outlined a scheme whereby, by the general adoption by bibliographical agencies of a standard classification, a comprehensive subject-index to published information of all kinds could be realised at once, with the saving of untold amounts of useless effort now wasted in repetition of previous work. It appeared that no other classification than the Decimal Classification, elaborated during more than thirty years by the collaborators of the Brussels Institute, came into discussion, and this classification is now being adopted as a standard by institutions of all kinds throughout the world.

Mr. Donker Duyvis, as secretary of the Commission of the Decimal Classification, gave his report on the present state of the printing of the new manual of the classification. About 1500 pages have now been printed, which brings the manual to the end of the

main divisions. The auxiliary tables and relative index remain to be printed. It was pointed out that the new manual has a provisional character and will serve as a basis for future enlarged editions. Various important improvements have been made and the theory of classification has been worked out in various respects and put into practice. The new manual is very comprehensive and provides at least a general class-number for practically every topic of human knowledge. Parts of the manual are being translated into five different languages. A mechanism is in existence for securing new sub-divisions as required, so as to keep the classification up-to-date.

The general assembly was opened on Tuesday, Sept. 17, with an address by the president, Prof. Pollard. In view of the visitors present, who included Sir Henry Lyons, Director of the Science Museum, as the representative of the Royal Society, Prof. Pollard first explained the function and work of the Institut. This function, he said, is, in effect, the economic distribution of means by which the information upon any given matter contained in the world's literature may be exhaustively extracted and immediately brought to light. The comparatively small but rapidly increasing literature of science is fed both by genius and exceptional intellects, which are in a class by themselves, and by those who labour in association. To the former the work of the Institut does not universally appeal, but the importance of bibliography to the latter is evidenced by the laboured bibliographies which are compiled by nearly all associative bodies concerned with scientific research and technological developments. For want of organised bibliography, the history of science and technology reveals much useless repetition and wasted effort, and even the circumscribed work of gifted intellects suffers from a neglect of bibliography.

The aim of the Institut International de Bibliographie is to provide the golden key which unlocks the treasure-house of the document, and is embodied in the study and application of bibliographical method. Daughter societies or branches of the Institut are being established in all countries of the world for the purpose of collecting, under the control of the Institut, in the most economical manner, and distributing to the student, the references to published information. It has been estimated that, if the work and labour now put into existing bibliographies were ordered and controlled, the ideal of a comprehensive index to the printed record might be realised now.

Prof. Pollard enumerated a number of important scientific societies, research associations, and bureaux in Great Britain which have adopted the methods of the Institut International de Bibliographie within the past year, chiefly through the activities of members of the British Society for International Bibliography, which has its headquarters at the Imperial College of Science and Technology, and is affiliated to the Institut. This is only a part of the first step that must be taken in order that the massed attack upon literature, which is gradually being organised by the Institut through the agency of affiliated bibliographical societies situated in civilised countries, may take effect to the lasting benefit of mankind.

An interesting discussion followed on the application of the Universal Decimal Classification and other schemes, in which the principal speakers were M. La Fontaine, Mr. Donker Duyvis, Mr. Rottenburg, Dr. Griffin, Mr. Lancaster Jones, Prof. Pollard, and Dr. Bradford. The discussion emphasised the important points that no unaided individual, however expert in a special subject, is capable in elaborating a satisfactory scheme of classification, and that a comprehensive index to published information can only be realised by the co-operation of many agencies using a standard code.

Aeronautical Research in Great Britain.

THE spectacular setting of the Schneider Cup Race and the terrific speeds of 360 m.p.h. at which the British pilots lapped the course tend to obscure the enormous mass of scientific work of which this fine achievement is one of the more dramatic illustrations. It is on the incredible speeds attained that the excited layman focuses his attention—the mere outward and visible sign—but the problems of engine design, of structural strength under the enormous stresses in turning, of stability and controllability, of the aerodynamic properties of propellers and the other exposed aeroplane parts—these lie masked behind this single item of speed performance.

How the study of these problems is organised and their solution slowly attained is once more made evident in the Annual Report of the Aeronautical Research Committee, for the year 1928–29.[1]

The fields of research pursued by the Committee cover such subjects as aerodynamics, stability and control, engines, alloys, elasticity and fatigue, while in addition a large degree of consideration has been devoted to the problems of interference of body parts and to wing flutter. New researches in these matters have been initiated, while matters dealt with in previous annual reports have reached a more advanced stage. Amongst these are the lateral control of aeroplanes at low speeds; auto slots, for example, have been fitted to a large number of service aircraft; pilot planes are in use on experimental aircraft, and various means of putting a slot out of action if necessary, when used in conjunction with an aileron, are under trial. An important research on flutter has been completed, while researches on sleeve valve engines, on engines when highly supercharged, and on compression ignition engines are progressing rapidly.

One of the problems that has received much attention during the past year is the intensive improvement of aeroplane performance. A wide disparity still exists between the total head resistance of an ideal aeroplane the drag of which is entirely due to skin friction and that of conventional aeroplanes of present design. Attempts to reduce this large difference constitute the object of researches already initiated, and it is anticipated that much of the work of the Committee in the near future will be concerned with this problem, as there is in this field considerable scope for research which should have valuable consequences.

Arising out of this, further light is being thrown on the interesting problem of 'scale effect', for which an allowance has to be made in the prediction of full-scale resistance from model data on good stream-line bodies. It appears to be the case that much of the uncertainty in the passage from model to full scale is due to the fact that in the former case the flow is not so completely turbulent as in the latter, so that the prediction will be less liable to error if the flow in the wind tunnel can be rendered sufficiently turbulent. This question of turbulence, including both the mechanism of its origin and its general effect on performance, is considered a matter of primary importance. Thus the practical problems of flight are continually being reduced to their dependence on pure research.

[1] Aeronautical Research Committee. Report for the year 1928–29. Pp. 63. (London: H.M. Stationery Office, 1929.) 2s.

Northern Echinoderms and Teleostei.

A VERY complete and up-to-date account of the echinoderms of the North Sea and Baltic is given by Th. Mortensen and I. Lieberkind in Lief. 12, Teil 8, Echinoderma, of Grimpe and Wagler's "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928). In the 128 pages a large amount of information is compressed and the whole résumé is of great value. Keys similar to those already given in Dr. Mortensen's larger works facilitate the identification of species, and the illustrations are beautifully clear and generously scattered throughout the text.

There are 69 species of echinoderms in the area described, and these are all tabulated with details of distribution, depth, and the nature of the bottom on or in which they live. Echinoderms are truly marine and do not tolerate brackish water. For this reason the low salinity of the Baltic does not encourage them: few species are to be found there, and these are never common. These few are *Astropecten irregularis*, *Henricia sanguinolenta*, *Solaster papposus*, *Asterias rubens*, *Ophiura albida*, *Psammechinus miliaris*, *Echinocyamus pusillus*, *Echinocardium flavescens*, and *Thyonidium pellucidum*. However, the North Sea harbours many of the species in great abundance and from between tide-marks to deep water (more than 3000 metres) they are to be found.

Following the systematic part, the anatomy is described in detail, movement, feeding (with a large amount of attention given to physiology), and finally reproduction and larval forms. Here again, clear keys are given for the identification of the larvæ of the commoner species in all groups. The echinoderm section of "Die Tierwelt der Nord- und Ostsee" is specially valuable and one of the best parts of this most useful work.

Georg Duncker and Erna W. Mohr give a good account of the Bleniiformes, Trachiniformes, and Gobiiformes (Teleostei, Physoclisti. 7-9. Blenniiformes, Trachiformes, Gobiiformes) in Lief. 12, Teil 12, g. 3 of "Die Tierwelt der Nord- und Ostsee". In the Gobiidae, *Gobius microps*, which only a few years ago was regarded as a variety of *G. minutus*, is now placed with *G. flavescens* (= *G. ruthensparri*) and *G. pictus*, whilst *G. minutus* is in a separate group. This is quite justified by the structural differences and now accepted by most systematists. Nearly all the British gobies are represented in this area, including *Aphya pellucida* and *Crystallogobius linearis* (= *C. nilssoni*), the Baltic Sea possessing a special race of *Gobius minutus*.

The eggs of the gobies are peculiarly interesting, being laid in masses, one layer thick, on shells and stones, each egg contained in a vase-like case, the shape characteristic of the species. Most of these eggs are known, the male parent watching over them until they are hatched.

In the Trachiformes comes the common angler, *Lophius piscatorius*, and a brief account is given of its wonderful ribbon of eggs, floating like a veil in the sea, and its well-known larval forms with figures after Smitt.

In connexion with the common blennies it is stated that neither egg nor larva is known of *Blennius gattorugine*. These are, however, both described in the *Journal of the Marine Biological Association* (vol. 12, No. 4, 1922, and vol. 14, No. 3, 1927). Also the authors assume that the pelagic larva of *Blennius pholis* is unknown, and this is also described by Ford in the first paper mentioned above.

University and Educational Intelligence.

Liverpool.—The Lady Herdman Memorial geology building of the University will be opened on Oct. 21 by the Right Hon. Stanley Baldwin.

London.—A farewell dinner to Sir Gregory Foster, who retires from the position of Provost of University College, London, at the end of this year, will be given by past and present students of the College on Friday, Dec. 20. Those wishing to attend the dinner are asked to inform Mr. B. N. Parker, honorary secretary of the Old Students' Association, at the College.

Accredited universities, colleges, and other institutions for higher education and research are listed in *Bulletin*, 1929, No. 7 of the United States Bureau of Education (Washington, D.C.: Government Printing Office, 1929. 10 cents). The Bureau does not itself accredit, approve, or classify educational institutions, but performs a service of great value in making easily accessible the estimates of the various regional and national standardising agencies which have undertaken this work, and the criteria with reference to which the estimates were framed. The following associations are represented in the *Bulletin*: American Council on Education, Association of American Universities, Associations of Colleges and Secondary Schools of the Middle States and Maryland, of the Southern States, of New England and of North Central States, American Associations of Junior Colleges, of Teachers' Colleges, of Collegiate Schools of Business, of Schools and Departments of Journalism, and of Colleges of Pharmacy, Council of Medical Education and Hospitals, Dental Education Council, and American Library Association.

Organisation of secondary education in two units of four years each is advocated in an article in the June issue of *School Life* by Dr. W. J. Cooper, United States Commissioner of Education. The typical American 'high school' of to-day, like its predecessors since the creation of this type of school a hundred years ago, offers courses covering four years, and more or less intermediate in standard between those of the seven or eight years of the elementary school and the traditional four-years' liberal arts college course. The rapid and continuous growth which has characterised secondary education in the United States since 1890 has radically altered the purposes of the teaching which the high schools are called upon to provide. Whereas in that year less than four per cent of the population of the appropriate ages (14-17) were enrolled in the high schools, the percentage had risen in 1926 to 47, and there has been a simultaneous rapid growth in racial heterogeneity and the complexity of the social order. Experiments in the reorganisation of the high school have been going on all over the United States, and one-sixth of all the public high schools could in 1926 be classed as 'reorganised', the commonest feature of reorganisation being a 'junior high school' embracing usually the seventh and eighth of the old elementary school grades with or without the lowest grade of the ordinary high school. Simultaneously with this downward extension of the high school has come an upward extension by the addition of 'junior colleges' offering two years of advanced work. Dr. Cooper's contention is that for the average child a secondary school organised under a 4-4 plan, allotting the first unit to the period of early adolescence and the second to that middle adolescent period in which intelligence normally reaches its climax, would prove most beneficial.

Calendar of Patent Records.

October 6, 1825.—An early example of 'caterpillar' traction for road vehicles, consisting essentially in the employment of an endless chain passing round the wheels on each side of the wagon, to enable the wagon to travel over rough ground, was patented on Oct. 6, 1825. It was the invention of Sir George Cayley (1773–1857), known to-day as one of the greatest of aeronautical pioneers.

October 6, 1886.—Hovis bread dates from the patent granted to Richard Smith, miller, of Stoke-on-Trent, on Oct. 6, 1886, for a process in which the bread is made from a mixture of three parts of white flour with one part of the wheat germ which has been partly cooked by subjecting it to the action of superheated steam.

October 7, 1839.—An important method of protecting tempera painting to render it washable is described in the specification of the patent granted to F. G. Spilsbury and others on Oct. 7, 1839. The tempera is applied to the surface by a careful preparation of chondrin size, and the painting when finished is washed over with a solution of alum or acetate of alumina, which renders the size insoluble in water.

October 7, 1847.—The plate-glass known as 'Hartley's' or 'Rolled', made by ladling the molten glass from the melting pot to the casting-table and rolling it out into large thin sheets, was patented on Oct. 7, 1847, by James Hartley of Sunderland, and first manufactured in the same year by Messrs. Chance Bros., of which firm Hartley for some time was a member.

October 7, 1852.—Dr. Augustus Waller appears in the patent lists as the inventor of a means for measuring the quantity of alcohol in brandy, wine, beer, or other liquor, which he patented on Oct. 7, 1852, but his most important invention—the cardiograph, which records the movements of the heart at any moment, was not patented.

October 8, 1890.—The Hornsby-Akroyd oil engine was a development of the engine invented by H. Akroyd Stuart and patented by him and C. R. Binney on Oct. 8, 1890. It was the first commercially successful engine to have the 'hot bulb' system of ignition, and was the forerunner of the so-called 'semi-diesel' engine. Its chief feature was that the hot-bulb was connected to the engine cylinder by only a narrow opening, and whilst the liquid fuel was injected under pressure into the hot-bulb and vaporised, the air was drawn into the cylinder and was not mixed with the vapour in the correct proportion to form the explosive mixture until the proper moment for the explosion.

October 10, 1826.—A metal wheel, designed so that the spokes of thin rod or wire should be in tension, was patented by Theodore Jones on Oct. 10, 1826. The patent was upheld in the courts in an action for infringement, and was extended for seven years in the names of Gabriel Riddle and Thomas Piper, to whom the patent had been assigned.

October 11, 1867.—The first Remington typewriter was made under the United States patent granted to C. Glidden and Latham Sholes on Oct. 11, 1867. (Cf. Calendar of Patent Records, Aug. 11.)

October 12, 1815.—The keel of the first steamboat to be built in Germany was laid down in June 1816 by an Englishman, J. B. Humphreys, who was granted a Prussian patent for ten years on Oct. 12, 1815. The *Prinzessin Charlotte* was employed on the route Berlin-Charlottenburg-Potsdam, but was not successful. The first commercially successful steamship to be built in Germany was *Die Weser*, which was begun in the autumn of 1816 and started working in the following May.

Official Publications Received.

BRITISH.

Northampton Polytechnic Institute, St. John Street, London, E.C.1. Announcements for the Session 1929–1930 giving Particulars of Evening Classes in Civil and Mechanical Engineering. Pp. 48. Announcements for the Session 1929–1930 giving Particulars of the Evening Classes in Electrical Engineering. Pp. 47. Announcements for the Session 1929–1930 giving Particulars of the Evening Courses in Applied Optics. Pp. 26. Announcements for the Session 1929–1930 giving Particulars of Day and Evening Courses in Applied Chemistry. Pp. 27. Announcements for the Session 1929–1930 giving Particulars of the Day Courses in Applied Optics. Pp. 24+4 plates. Prospectus of the Northampton Engineering College for the Session 1929–30. Pp. ii+41+7 plates. (London.)

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 7: A Persian Translation of the Eleventh Century Arabic Alchemical Treatise *'Ain as-San'ah wa 'Aun as-Sana'ah*. By Maqbūl Ahmad; to which is annexed a Note on the Chemistry of the Processes given in the Treatise, by Prof. B. B. Datta. Pp. 417-460. (Calcutta.) 1.11 rupees.

London County Council: Hackney Technical Institute. Prospectus and Time Table, 1929–30. Pp. 74. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 25: A Study of Fungi found in Milk. By Prof. H. A. Cummins, Violet C. E. Kennelly and M. Grimes. Pp. 311-319+plates 17-18. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6d.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee, Part 16. Pp. 291-341. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.)

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-fourth Session, 1929–1930. Pp. 438+xxviii. (Glasgow.)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929. Vol. 49, Part 4, No. 23: On Three Huygens Lenses in the possession of the Royal Society of London. By Prof. R. A. Sampson and Prof. A. E. Conrady. Pp. 289-299+2 plates. 1s. 6d. Vol. 49, Part 4, No. 24: The Action of Salts of Polynuclear Bases on Colloidal Suspensions and on the Electro-capillary Curve. By Dr. J. A. V. Butler and Dr. W. O. Kermack. Pp. 300-312. 1s. Vol. 49, Part 4, No. 25: An Experimental Analysis of the Plumage of the Brown Leghorn Fowl. By A. W. Greenwood and J. S. S. Blyth. Pp. 313-355+4 plates. 5s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1928. Pp. 86. (Reading.)

The Electrical Association for Women. What Women Think about Electrical Development in Great Britain, U.S.A., Holland and Germany: being Report of Proceedings of the Fourth Annual Conference held at the North-East Coast Exhibition, Newcastle-on-Tyne, July 10th-12th, 1929. Pp. 32. (London.) 1s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 27: The Insect Vectors of the Leaf-Roll Disease of the Potato. By Dr. Paul A. Murphy and Robert McKay. Pp. 341-353. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Proceedings of the Royal Irish Academy. Vol. 38, Section C, Nos. 8, 9: Further Notes on the Runic Inscription in Killaloe Cathedral, by R. A. S. Macalister; On some Antiquities discovered upon Lambay, by R. A. S. Macalister. Pp. 235-246+plates 20-25. 1s. Vol. 38, Section C, No. 10: Report on Excavation recently conducted in Killeen Cormac, Co. Kildare. By R. A. S. Macalister and R. Lloyd Praeger. Pp. 247-261+plates 26-30. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

British Broadcasting Corporation. Broadcasts to Schools. Programme, September 1929 to June 1930; Syllabus, September 23 to December 13, 1929. Pp. 36. Speech and Language. By A. Lloyd James. Broadcast Thursdays 2.30 to 2.50 p.m., September 1929 to June 1930. Pp. 24. 1d. Elementary French. Manual No. 4, specially designed for Central Schools, by E. M. Stéphan. Broadcast on Tuesdays, 24 September–10 December 1929, 3.35 p.m.–4.0 p.m. Pp. 28. 1d. Music Lessons. Scholar's Manual 1, by Sir Walford Davies. Broadcast on Tuesdays, 24 September 1929–10 December 1929, 2.30–3.30 p.m. Pp. 44. 1d. Days of Old. By Rhoda Power. Term 1: The Middle Ages; with Illustrations from Contemporary Sources by Elinor Lambert and Others. Broadcast on Mondays, 23 September to 9 December 1929, 2.30–3 p.m. Pp. 32. 1d. Peoples of the World and their Homes. Planned by Prof. H. J. Fleure. Term 1. Broadcast on Fridays, 27 September–13 December 1929, 3.0–3.20 p.m. Pp. 32. 1d. Rural Survey, Term 1, by Charlotte Simpson, Broadcast on alternate Fridays, 27 September–6 December 1929, 2.30–2.55 p.m., and Farming, Term 1, by Dr. B. A. Keen, Broadcast on alternate Fridays 4 October–13 December 1929, 2.30–2.55 p.m. Pp. 36. 1d. Readings and Talks for Secondary Schools. Readings, Mondays, 2.0–2.20 p.m., 23 September–9 December 1929; Talks, Tuesdays, 4.15–4.30 p.m., 24 September–10 December 1929. Pp. 32. 1d. Nature Study, Term 1. By Clotilde von Wyss. Broadcast on Wednesdays, 25 September–11 December 1929 (omitting 2 October), 2.30–2.55 p.m. Pp. 20. 1d. (London.)

British Broadcasting Corporation. Talks and Lectures. The Meaning of Ethics. By Prof. W. G. de Burgh. From Daventry 5XX only, Tuesdays, September 24 to October 29, at 8 p.m. (Aids to Study, No. 47.) Pp. 16. 1d. The Village and the Village Craftsman. Arranged in co-operation with the Rural Industries Bureau. Fridays, September 27 to November 1, at 7.25 p.m. (Aids to Study, No. 48.) Pp. 32. 1d. (London.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1220 (M. 60): The Age-Hardening of some Aluminium Alloys. By Dr. Marie L. V. Gayler and G. D. Preston. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (A. 51.) Pp. 33+22 plates. (London: H.M. Stationery Office.) 2s. net.

Rubber Research Institute of Malaya. Annual Report, 1928, including Initial Period. Pp. 127. (Kuala Lumpur, F.M.S.) 1 dollar.

Annual Report of the Director of the Meteorological Office, presented by the Meteorological Committee to the Air Council, for the Year ended 31st March 1929. (The Seventy-fourth Year of the Meteorological Office.) (M.O. 318.) Pp. 46. (London: H.M. Stationery Office.) 1s. 6d. net.

Annual Conference of the Universities of Great Britain and Ireland, 1929. Report of Proceedings. Pp. 59. (London: Universities Bureau of the British Empire.) 1s.

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1928–29. Vol. 30. Pp. 76+2 plates. (Leicester.)

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi in 1927, observed and reduced under the direction of Dr. J. M. Baldwin. Pp. viii+37. (Melbourne: H. J. Green.)

Indian Journal of Physics, Vol. 4, Part 2; and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 2. Conducted by Sir C. V. Raman. Pp. 79-193+5 plates. (Calcutta.) 3 rupees; 4s.

Department of Agriculture, Ceylon. Administration Report of the Acting Director of Agriculture for 1928. Pp. D26. (Colombo: Government Record Office.) 50 cents.

Ceylon. Administration Report of the Acting Marine Biologist for 1928. Pp. G24+2 plates. (Colombo: Government Record Office.) 75 cents.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1929; with Appendices. Pp. 46. (London: H.M. Stationery Office.) 1s. 6d. net.

Journal of the Royal Statistical Society. New Series, Vol. 92, Part 4, 1929. Pp. viii+487-669. (London.) 7s. 6d.

Ministry of Health. Report of Departmental Committee on the Training and Employment of Midwives. Pp. 96. (London: H.M. Stationery Office.) 1s. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 393, September. Pp. 1065-1176+xxxvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1928 to 31st March 1929. Pp. 13+5 plates. (London: H.M. Stationery Office.) 4s. 6d. net.

Birkbeck College (University of London). The Calendar for the Year 1929–30. (107th Session.) Pp. 242. (London.)

Birkbeck College (University of London). Lord Haldane's Life and the Adult Education Movement: being the first Annual Haldane Memorial Lecture delivered by the Rt. Hon. Lord Justice Sankey, May 14th, 1929. Pp. 23. (London.)

Heriot-Watt College, Edinburgh. Calendar, Session 1929–1930. Pp. 281. (Edinburgh.) 1s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1211 (E. 30): The Effective Torsional Rigidity of a Crank. By R. V. Southwell. (I.C.E. 606: T.V.C. 28.) Pp. 17. (London: H.M. Stationery Office.) 9d. net.

Department of the Interior. Waterton Lakes National Park, Alberta, Canada. By M. B. Williams. Pp. 45. Jasper National Park. By M. B. Williams. Pp. iv+176. Through the Heart of the Rockies and Selkirks. By M. B. Williams. Fourth edition. Pp. vi+112. Kootenay National Park and the Banff Windermere Highway. By M. B. Williams. Pp. 45. Prince Albert National Park. By M. B. Williams. Pp. 24. (Ottawa: F. A. Acland; London: High Commissioner of Canada.)

Indian Journal of Physics, Vol. 4, Part 3; and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 3. Conducted by Sir C. V. Raman. 14: A Memoir on the Raman Effect in Liquids. By Dr. A. S. Ganesan and S. Venkateswaran. Pp. 195-280+plates 6-9. (Calcutta.) 2.4 rupees; 3s.

Transactions of the Mining and Geological Institute of India. Vol. 24, Part 1, July. Pp. 77+3 plates. (Calcutta.) To Members, 2.8 rupees; to Non-Members, 4 rupees.

Union of South Africa. Department of Mines and Industries: Geological Survey. The Geology of the Country surrounding Pretoria: an Explanation of Sheet No. 1 (New Series). By H. Kynaston. Revised by Dr. L. J. Krige and B. V. Lombard. Pp. 48. (Pretoria: Government Printer.) 5s. (including Map).

Southern Rhodesia: Geological Survey. Bulletin No. 14: The Geology of the Gaika Gold Mine, Que Que, S. Rhodesia. By S. C. Morgan. Pp. 42+5 plates. Short Report No. 24: An Outline of the Geology of Southern Rhodesia. By H. B. Maufe. Second edition. Pp. 12+2 maps. (Salisbury.)

Report of the Nineteenth Meeting of the Australasian Association for the Advancement of Science (Australia and New Zealand). Hobart Meeting, January 1928. Pp. xl+707+17 plates. (Sydney, N.S.W.)

Southern Rhodesia. Report of the Director of Native Education for the Year 1928. Pp. 48. Report of the Director of Education for the Year 1928. Pp. 32. (Salisbury: Government Printer.)

Wigan and District Mining and Technical College. Calendar 1929–1930. Pp. 212. (Wigan.)

Annual Report for the Year ended March 31st, 1929, of the Executive Council of the National Institute for the Blind. Pp. iv+56. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), Nos. 20-28. 20: A Study of Lactose-Fermenting Yeasts isolated from Milk, Cream and Butter, by M. Grimes and J. Doherty; 21: The Effect of Strong Magnetic and Electric Fields on the Rectilinear Propagation of γ Rays, by Dr. J. H. J. Poole and A. G. Clarke; 22: On the Local Application of Radium in Therapeutics, by Prof. J. Joly—ii: Bi-Radiant Needles; 23: Report of the Irish Radium Committee for the Year 1928 (including Reports by Dr. Walter C. Stevenson and M. R. J. Hayes); 24: Photo-electric Measurements of Illumination in relation to Plant Distribution, by Dr. W. R. G. Atkins and Dr. H. H. Poole—Part 2: Measurements with Portable Galvanometers; 25: A Study of Fungi found in Milk, by Prof. H. A. Cummins, Violet C. E. Kennelly and M. Grimes; 26: The Uranyl Oxalate Method of Daylight Photometry and its Photo-electric Standardization, by Dr. W. R. G. Atkins and Dr. H. H. Poole; 27: The Insect Vectors of the Leaf-Roll Disease of the Potato, by Dr. Paul A. Murphy and Robert M'Kay; 28: The Photo-chemical and Photo-electric Measurement of the Radiation from a Mercury Vapour Lamp, by Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 261-364+plates 16-18. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 8s.

FOREIGN.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 4, No. 2. Pp. 335-471+plates 13-18. (Tokyo and Sendai: Maruzen Co., Ltd.)

Union Géodésique et Géophysique Internationale: Section de Météorologie. Troisième assemblée générale, Prague 1927. Pp. 48. (Cambridge: At the University Press.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 8, août. Pp. 417-466. (Prague: Regia Societas Scientiarum Bohemica.)

United States Department of Agriculture. Circular No. 75: The True Cricket, a Serious Cotton Pest in California. By E. A. McGregor. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 17, pour l'année 1927. Pp. 72. 2.75 kr. Rapports et procès-verbaux des réuniones. Vol. 58: Tables des matières de Vol. 1-65 et liste des publications de circonstance avec table alphabétique des matières (finissant avec le 1er avril 1929). Pp. 58. 2.25 kr. (Copenhague: Andr. Fred. Høst et fils.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 10, Livraison 4, juin. Pp. 403-517+plates 11-15. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Publications of the Astronomical Observatory of the Warsaw University. Vol. 4. Pp. iii+95. (Warsaw.)

Bulletin of the National Research Council. No. 51: Radioactivity; Report of Committee on X-Rays and Radioactivity, National Research Council. By Prof. A. F. Kovarik and Prof. L. W. McKeehan. Second printing, with Additions and Corrections. Pp. viii+203. (Washington, D.C.: National Academy of Sciences.) 2.50 dollars.

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 12, No. 4, July. Pp. 203-226+3 plates. (Tokyo: Maruzen Co., Ltd.) 1.30 yen.

Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 6, No. 2, July. Pp. 173-249. (Tokyo: National Research Council of Japan.)

Proceedings of the Imperial Academy. Vol. 5, No. 7, July. Pp. xv-xvi+263-305. (Tokyo.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 23, Part 4: Arbeiten aus dem Institute für Gerberei-Wissenschaft. Mitteilung 5: Über gerbende Stoffe und ihre Beurteilung. Von Prof. Dr. G. Grasser und Sun Tau. Pp. 127-150. (Tokyo: Maruzen Co., Ltd.)

The Danish *Dana* Expeditions, 1920–22, in the North Atlantic and the Gulf of Panama. Oceanographical Reports, edited by the *Dana* Committee, No. 4: Les poissons apodes appartenant au sous ordre des Nemichthydiformes. Par Prof. Louis Roule et Léon Bertin. Pp. 113+9 planches. (Copenhagen: Gyldendalske Boghandel; London: Wheldon and Wesley, Ltd.) 18s.

Publication of the Netherlands Geodetic Commission. Theory and Practice of Pendulum Observations at Sea. By F. A. Vening Meinesz. Pp. viii+95. (Delft: J. Waltman, Jr.)

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin, No. 34: Magnetic Declination in the Nile Valley for the Epoch 1930·0. By P. A. Curry. Pp. 2+1 plate. (Cairo: Government Press.)

Ministry of Agriculture, Egypt: Technical and Scientific Service (Botanical Section). Bulletin No. 90: A Preliminary Note on some New Strains of Uppers. By C. H. Brown. Pp. 10+44 plates. (Cairo: Government Press.) 5 P.T.

The Carnegie Foundation for the Advancement of Teaching. Twenty-third Annual Report of the President and of the Treasurer. Pp. vi+166. (New York City.)

Sveriges Geologiska Undersökning. Ser. C, No. 346: Studier över Ancylussjöns avlopp. Av Henr. Munthe. Pp. 107+4 tavlor. 3.00 kr. Ser. C, No. 347: Svea ölvs geologiska tidsställning; en pollenanalytisk studie i Ancylustidens geografi. Av Lennart von Post. Efterskrift: Ancylustidens Göta älv. English Summary: The Geological Age of the Svea River. Pp. 132+2 tavlor. 3.00 kr. Ser. C, No. 348: Undersökningar angående det senglaciala havets största utbredning inom Norrbottens län. Av Gösta Santesson. Pp. 13+1 tavla. 1.00 kr. Ser. C, No. 349: Senglaciala strandlinjer och sediment i västra Bergslagen. Av Erik Granlund. Pp. 38+1 tavla. 1.00 kr. Ser. C, No. 350: Södra Storfjället im südlichen Lappland; eine petrographische und geologische Studie im zentralen Teil des skandinavischen Hochgebirges. Von Gunnar Beskow. Pp. 335+2 Tafeln. 5.00 kr. Ser. C, No. 351: Masugnsbyfältens geologi. Av Per Geijer. Summary: Geology of the Iron Ore Fields at Masugnsbyn. Pp. 39+1 karta. 1.00 kr. Ser. C, No. 352: Nyare jordarts- och markreaktionsundersökningar och deras betydelse för jordbruket. Av Simon Johansson. Pp. 16+2 tavlor. 1.00 kr. Ser. C, No. 353: Studier i Ölands myrmarker. Av G. Lundquist. Resumee in deutscher Sprache. Pp. 183+9 tavlor. 3.00 kr. Ser. C, No. 354: Kalirika bergarter inom södra och översikt av den svenska experimentverksamheten för framställning av kaligödselmedel. Av B. Asklund. Pp. 52+1 tavla. 1.00 kr. Ser. C, No. 355: A Deep Boring through Middle and Lower Cambrian Strata at Borgholm, Isle of Öland. By A. H. Westergård. Pp. 19. 1.00 kr. (Stockholm.)

United States Department of Agriculture. Technical Bulletin No. 88: Tobacco Cutworms. By S. E. Crumb. Pp. 179+9 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

Bulletin of the American Museum of Natural History. Vol. 58, Art. 8: Notes on Reptiles from Fukien and other Chinese Provinces. By Clifford H. Pope. Pp. 335-487+plates 17-20. Vol. 58, Art. 9: Nicolas Pike and his Unpublished Paintings of the Fishes of Mauritius, Western Indian Ocean; with an Index to the Fishes. By E. W. Gudger. Pp. 489-530. Vol. 58, Art. 10: An Adult Pug-headed Brown Trout, *Salmo fario*, with Notes on other Pug-headed Salmonids. By E. W. Gudger. Pp. 531-559+plate 21. (New York City.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 48: On the Stability of Kármán Vortex Street in a Channel of Finite Breadth, I. By Susumu Tomotika. Pp. 213-242. (Tôkyô: Koseikai Publishing House.) 0.32 yen.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 18, No. 13: The Escallonias in Golden Gate Park, San Francisco, California, with Descriptions of New Species. By Alice Eastwood. Pp. 385-391. Vol. 18, No. 14: Studies in the Flora of Lower California and adjacent Islands. By Alice Eastwood. Pp. 393-484+plates 33-34. (San Francisco.)

Japanese Journal of Chemistry: Transactions and Abstracts. Vol. 3, No. 4. Pp. 165-215. Vol. 4, No. 1. Pp. 31. (Tokyo: National Research Council of Japan.)

The Philippine Journal of Science. Vol. 39, Nos. 1-4: Filterable Virus and Rickettsia Diseases. By Earl Baldwin McKinley. Pp. iii+416+70 plates. (Manila: Bureau of Printing.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 89: Observations on the Thunder Dance of the Bear Gens of the Fox Indians. By Truman Michelson. Pp. v+73. 65 cents. Bulletin 92: Shabik'eshchee Village, a late Basket Maker Site in the Chaco Canyon, New Mexico. By Frank H. H. Roberts, Jr. Pp. viii+164+31 plates. 1.00 dollar. (Washington, D.C.: Government Printing Office.)

Forty-fourth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1926-1927. With accompanying Papers: Exploration of the Burton Mound at Santa Barbara, California, by John P. Harrington; Social and Religious Beliefs and Usages of the Chickasaw Indians, by John R. Swanton; Uses of Plants by the Chippewa Indians, by Frances Densmore; Archeological Investigations, II., by Gerard Fowke. Pp. vii+555+98 plates. (Washington, D.C.: Government Printing Office.) 2.25 dollars.

Year Book of the Academy of Natural Sciences of Philadelphia, 1928. Pp. 90+11 plates. (Philadelphia.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 80, 1928. Pp. iv+640+31 plates. (Philadelphia.) 6.25 dollars.

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1928. By William Henry Fox. Pp. 73+3 plates. (Brooklyn, N.Y.)

CATALOGUES.

A Catalogue of Miscellaneous Books (Folklore, Witchcraft, etc.; Biography and History; General Literature). (No. 447.) Pp. 32. (Cambridge: Bowes and Bowes.)

East Africa: a Short List of Books relating to Uganda, Kenya, Somaliland, Tanganyika, Portuguese East Africa, etc. Pp. 8. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 4.

DIESEL ENGINE USERS ASSOCIATION (at Caxton Hall), at 6.—G. B. Fox: Indicating Oil Engines.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. R. H. Pickard: The Industrial Research Association.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. J. Hill: Engineering Experiences on a Tea Estate in Assam.

SATURDAY, OCTOBER 5.

BIOCHEMICAL SOCIETY (in Biochemical Laboratory, Cambridge), at 3.—Sir F. G. Hopkins: Glutathione as a Tripeptide.—G. F. Marrian: An Unidentified Saturated Alcohol in the Urine of Pregnancy.—W. M. Wright and C. G. L. Wolf: The Fuchs Reaction for the Diagnosis of Malignant Tumours.—L. H. Stickland: The Bacterial Decomposition of Formic Acid.—J. Needham and D. M. Needham: Phosphorus Metabolism of Developing Echinoderm Eggs.—W. B. Pleass: Cooling and Heating Curves of Solutions of Gelatin and the Influence of Hydrogen Ion Concentration on the Gelling of Gelatin Sols at Various Temperatures.—H. J. Channon and G. A. Collinson: The Acetone-ether Soluble Fraction of the Fat of Blood at Fasting Level.—D. R. McCullagh: The Measurement of Heat Production in Biological Material by Means of a Resistance Thermometer.—*Demonstrations*:—J. R. M. Innes and L. J. Harris: The Histopathology of Hypervitaminosis-D.—D. R. McCullagh: Microcalorimeter.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Dr. P. B. Ballard: A Talk about Modern Methods.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—E. A. Martin: Gilbert White and his Village.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—E. Longden: Presidential Address.

MONDAY, OCTOBER 7.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Dr. E. O. Lewis: The Incidence of Mental Defect in the School Population.

INSTITUTION OF AUTOMOBILE ENGINEERS (British Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—Prof. W. Morgan: The Member and the Institution.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—H. A. Sloman: A New Method for the Production of Pure Beryllium Oxide from Beryllium Ores.—R. Taylor: Isolation of Helium from Monazite Sand.

TUESDAY, OCTOBER 8.

UNIVERSITY OF MANCHESTER CHEMICAL SOCIETY, at 5.—Dr. F. Challenger: Some Chemical Aspects of Microbiology (Presidential Address).

INSTITUTE OF MARINE ENGINEERS, at 6.30.—E. Berg: Electric Propulsion as applied to Passenger Liners.

ILLUMINATING ENGINEERING SOCIETY (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 6.30.—Report on Progress in Illuminating Engineering.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Prof. W. Morgan: The Member and the Institution.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—S. G. Homfray: Chairman's Address.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. A. Smith: The Life of the Rock-pools.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Leicester College of Technology), at 8.—R. B. Pilcher: Alchemy in Art and Literature.

WEDNESDAY, OCTOBER 9.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—J. H. Grant: Chairman's Address.

INSTITUTE OF BREWING (Burton-on-Trent Section) (at Queen's Hotel, Burton-on-Trent).—H. E. Dryden and others: Discussion on Heavy Malts as compared with Light Malts.

THURSDAY, OCTOBER 10.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—J. C. Stobart: Mass Methods.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—C. R. Fairey: The Range of Aircraft.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—J. D. North: Metals in Aircraft Structures.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—Dr. S. W. Smith: Some Factors in Solidification (Chairman's Address).

OPTICAL SOCIETY (at Imperial College of Science and Technology).—T. H. Court and Dr. M. von Rohr: The Development of the Telescope, mostly after Documents in the Court Collection (1675-1830). (Third Paper on the Court Collection.)—Dr. D. S. Perfect: A Chromatic Method of making Null Indications.

FRIDAY, OCTOBER 11.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Allen: Coal and Coal Cleaning.

LEICESTER TEXTILE SOCIETY (at Leicester), at 7.30.—J. W. Allinson: Colour and Design in Textile Printing.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. C. Robinson: Some Notes on the Selection of Suitable Metals to Resist Corrosion (Chairman's Address).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—J. D. Pratt: Rationalisation—its Meaning and Application; with Special Reference to the Chemical Industry.

EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. O. E. Lewis, Dr. Newth, and others: Mental Deficiency.

SATURDAY, OCTOBER 12.

MINING INSTITUTE OF SCOTLAND (at Edinburgh).

PUBLIC LECTURES.

TUESDAY, OCTOBER 8.

BRITISH MEDICAL ASSOCIATION, at 4.—Sir Josiah Stamp: Alcohol as an Economic Factor (Norman Kerr Memorial Lecture).

KING'S COLLEGE, at 5.—Dr. J. W. Pickering: Blood Plasma and Platelets. (Succeeding Lectures on Oct. 15, 22, 29, and Nov. 5.)

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL, at 5.—Dr. A. St. G. Huggett: The Physiology of the Fœtus. (Succeeding Lectures on Oct. 15, 22, and 29.)

WEDNESDAY, OCTOBER 9.

KING'S COLLEGE, at 5.30.—Rev. Canon C. Jenkins: The Contribution of King's College to the Advancement of Learning during the Century 1829-1928:—Theology and Philosophy.—Dr. F. A. P. Aveling: Personalism: A Psychological Approach to Reality:—Psychology and Psychologies.

FRIDAY, OCTOBER 11.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. R. Thurnwald: The Problem of Evolution in the Social Processes. (Succeeding Lectures on Oct. 15 and 17.)

KING'S COLLEGE, at 5.30.—Sir St. Clair Thomson: Lord Lister: Reminiscences of a House Surgeon.

SATURDAY, OCTOBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: Mammoth and Man.

CONFERENCES.

OCTOBER 4 TO 6.

COAL SMOKE ABATEMENT SOCIETY AND SMOKE ABATEMENT LEAGUE OF GREAT BRITAIN (at Palace Hotel, Buxton).

OCTOBER 10 TO 12.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS (at Connaught Hall, Newcastle-upon-Tyne).

Thursday, Oct. 10.—Dr. H. Mess: Tuberculosis on Tyneside: a Sociological Study.

Dr. E. Rist and others: The Factors that produce Pulmonary Tuberculosis.

Friday, Oct. 11.—Dr. W. Brand: A Scheme of National Propaganda regarding Tuberculosis.

Dr. A. H. Macpherson: Combined Treatment and Technical Education of Tuberculous Youths.

Dr. T. Beattie and Dr. F. Hewat: The Teaching of Tuberculosis to Undergraduates.

Dr. W. H. Dickinson: The Training of Tuberculosis Medical Officers.

Dr. H. Williams: Methods of Medical Propaganda regarding Tuberculosis.

Dr. W. Guy: Dentistry in Relation to Tuberculosis.

NATURE

SATURDAY, OCTOBER 12, 1929.

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No. 3128, Vol. 124]

The Royal Commission on the Civil Service.

THE announcement by the late Government of its intention, if returned to power, to set up a Royal Commission on the Civil Service was received by us with satisfaction, which was heightened when Mr. Churchill afterwards informed the House of Commons that "the object of the Royal Commission is, not to shelve, but to undertake a dispassionate and informed examination of the Civil Service from the point of view of its efficiency as a national instrument and of its own well-being". These spacious phrases seemed to be indicative of a change of attitude towards the administrative machinery of the State and to offer a possibility of an ordered approach to the problem of efficient public administration, the solution of which is as vital to the well-being of the community as that of the parallel problem which British industry under the stress of adversity has at long last begun to face.

With the change of Government some uncertainty existed until early in July, when the Prime Minister indicated the intention of the present Government to set up a Royal Commission with terms of reference "so framed as to bring all matters of general importance affecting the Civil Service within the scope of the inquiry". The actual terms of reference have now been announced as follows :

(1) The structure and organisation of the Civil Service, including methods of recruitment.

(2) Conditions of service in the Civil Service with reference to—

(*a*) The general standard of remuneration of civil servants and the existing differentiation between the rates and scales of remuneration payable respectively to men and women civil servants ;

(*b*) Machinery for the discussion and settlement of questions relating to conditions of service ; and

(*c*) The position of ex-Service civil servants in unestablished employment.

(3) Conditions of retirement from the Civil Service, including the retirement of women civil servants on marriage.

With these terms of reference we have no fault to find, for they permit of a thorough scrutiny of the present system, as well as an examination of the numerous grievances alleged by the civil servants' organisations, with which the existing Whitley machinery has apparently been unable to cope. The Commissioners are also to report upon

two questions of social policy affecting the employment of women by the State which have been the subject of prolonged controversy, and in favour of one of which, namely, equal pay for men and women engaged on similar duties, the House of Commons has already committed itself on two occasions.

When, however, we turn to the list of the members of the Commission, our emotion can mildly be described as one of bewildered amazement. Of sixteen members, including the chairman, who is an eminent lawyer, not one is a scientific man, not one is engaged in the application of science to the needs of the community, and not one is in the public mind as having devoted consideration to the problems of public administration. Instead, we find that no fewer than seven are or have been connected with the administration of education, and six are Members of Parliament, mainly not with wide administrative experience. Apologists have stated that the aim of the Government has been to select persons who have not revealed any prejudices on the matters referred to the Commission, but in an age when progress is so completely dependent on scientific knowledge and methods it is almost incredible that absence of opinion flowing from lack of either experience or study of a subject is to be deemed a primary qualification for service on a public inquiry of this importance.

If the problems facing the Commissioners were purely economic, if they were required to confine themselves merely to matters chiefly of domestic interest to civil servants, such a Commission would doubtless have proved adequate though uninspired. But something more is involved than the emancipation of women or the contentment of the Civil Service with their conditions of employment. Great Britain has been for a long period in the throes of an industrial crisis which, if prolonged indefinitely, must have a profound effect on the standard of living of every member of the community. Whatever may be the causes of the present industrial situation, it is certain that no remedy can be found other than by the fullest application of scientific methods and discoveries to the problems of industrial production. This process of industrial recovery can be assisted and stimulated by the State by the impetus it can give to pure research, by the policy it pursues in those spheres where public intervention is regarded as appropriate, and by the co-ordination of national effort and the development of national resources that it alone is in a position to undertake. With these duties confronting them, a peculiar responsibility must fall upon the permanent civil servants who act as the advisers of Ministers.

With this increasing dependence of industry upon Governmental action, and the growing intervention of the State in the social life of the people, it has become imperative that the Civil Service should be critically examined as regards both structure and personnel from the point of view of the demands that are now being made and will in future be made upon it. We hold that the public departments will never achieve their maximum efficiency or be in a position to make their proper contribution to the solution of present-day industrial difficulties unless a greater effective share in administration is accorded to the scientific and technical expert.

We have repeatedly referred to the inadequacy of the status and consequently of the salaries of the scientific and technical experts employed in Government departments. In the departments where professional knowledge and training are essential, the professional officer is in almost every instance definitely subordinated to administrators whose education, however rigorous as an intellectual discipline, has little regard to the place of science in the modern community. So strong is the monastic tradition of culture that in the competition for administrative posts in the Civil Service the dice have been deliberately loaded in favour of those who have specialised in the humanities rather than in pure science. Coupled with this limitation of the field from which the administrative element is drawn has been the practical debarment of professional and scientific Civil Servants from promotion to posts of administrative rank. It is officially stated that in fact no bar exists, but apart from the Department of Scientific and Industrial Research, we are unaware of any department where the permanent secretary is, for example, a trained scientific worker or engineer.

The classic example of the subordination of the technical expert is afforded by the Post Office, which administers under Treasury control great nationalised services. The Engineering Department which is responsible for the technical side of the telephone and telegraph services is presided over by the Engineer-in-Chief, who has under his charge a staff running into tens of thousands, from professional engineers downwards. His basic salary is £1500 a year, which with bonus is equivalent to about £1700. He is subject to the administrative

control of the secretariat, the head of which is the Permanent Secretary with an inclusive salary of £3000. No Engineer-in-Chief, however gifted administratively, can ever expect to be promoted to an administrative post even in control of such a distinctively technical service as that of the telephones. There are, indeed, only four professional men in the Service in receipt of salaries of more than £2000, the highest being £2500. In the scientific departments the position is worse, for no head of a scientific department of the Service is in receipt of a basic salary exceeding £1500.

The disparities between the careers open to administrators on one hand, and professional and scientific officers on the other, are but the reflection of the low status deemed appropriate to the latter, and this state of affairs will never be remedied by reform from within the Service, dominated as it is by 'establishment' traditions extending over several generations. This urgent problem of the status and functions of the scientific and technical experts in the public service is clearly suitable for consideration by an outside body, and it was our hope that a strong and representative Royal Commission composed of persons of acknowledged authority, even if handicapped by the possession of opinions based on knowledge and experience, would advise the nation on the whole question. Such a Commission should obviously contain an adequate representation of scientific and professional interests, for experience of committee working shows that the practical justification of this laborious system of arriving at a report on an administrative question is in the education of the less well-informed by the well-informed. The scientific and professional point of view will doubtless be effectively put to the Commission by evidence from such organisations as the Institution of Professional Civil Servants and the Association of Scientific Workers, but, particularly in a body which has been selected on the basis which has been indicated, the need for exposition and elucidation after the witnesses have withdrawn will be overwhelming.

Leading members of the Labour Party have on many occasions associated themselves with the aims of progressive science and referred to the important services rendered by scientific workers to the modern State. We have always advocated this community of spirit between Science and Labour, and we are greatly disappointed that, now the Labour Party is in power, it should disregard so completely the essential place of Science in the Commission which has just been appointed.

Sir Joseph Wilson Swan.

Sir Joseph Wilson Swan, F.R.S. A Memoir by M. E. S. and K. R. S. Pp. 183 + 6 plates. (London: Ernest Benn, Ltd., 1929.) 7*s.* 6*d.* net.

THE biography of Sir Joseph Wilson Swan, written by two of his children, gives an admirable record of the life of this great inventor. His inventions in connexion with photography and electric lighting place him in the front rank of the world's benefactors. Important industries employing tens of thousands of workmen are founded on the results of his labours. His most successful inventions are the carbon process (better known perhaps as the 'autotype' process); bromide printing paper familiar to all photographers; the incandescent carbon filament electric lamp; the cellular lead plate electrical storage battery, and the most important of all, artificial cellulose thread, the prototype of artificial silk.

Swan was born at Sunderland in the year 1828. His parents belonged to families of Scotch descent who had settled in the county of Durham about the middle of the eighteenth century. Swan's father had a bent towards a seafaring life, but circumstances prevented him and so he had to content himself with a comfortable business on shore making ship's anchors and chains. Later, ill-success in business deprived his children of an easy start in life, but they undoubtedly inherited from him many of the fine qualities which so endeared Joseph Swan to his friends.

When an old man, Swan wrote a few biographical details of his early life which illustrate some of the amazing changes which have taken place in comparatively recent times. "The days of my youth", he says, "extend backward to the dark ages, for I was born when the rush-light, the tallow-dip, or the solitary blaze of the hearth were common means of indoor lighting." In the houses of the rich wax candles were used. Outdoor illumination was derived from lamps raised on wooden posts about ten feet high. The lamps consisted of glass bowls containing about a cupful of evil-smelling train oil in which a cotton wick was immersed. The watchman with his lantern and rattle went his rounds calling out the time and describing the weather.

Joseph was sent first to a dame's school, where his imagination was stirred by the effects produced by light passing through a glass prism and the spark from a Leyden jar. He afterwards joined his brother at a large boys' school near Sunderland. Here he learnt how to manipulate laboratory apparatus and to make and store gases. The

pyrotechnic side of chemistry attracted him most. He left school when he was thirteen years of age, and for three years he was a druggist's apprentice at Sunderland. His duties were commonplace, but he was a member of the Sunderland Athenæum and had access to an excellent library. He remembered reading in 1845 with the greatest interest an account of an 'incandescent electric lamp' invented by a young American, J. W. Starr. During these three years Swan writes, "All my spare time was spent in chemical and electrical experiments carried out for the most part by means of home-made apparatus and appliances".

Swan was strongly attracted by electrotyping, afterwards developed into electroplating, and used various types of primary battery for the purpose. One day when passing a shop window in Sunderland he caught a glimpse of a daguerreotype portrait. He paid many visits to this window, with constantly increasing wonder at this scientific achievement. He had heard of the conjuror's hoax of your likeness seen in a mirror and fixed there by a process of baking. Here was fiction turned into fact, a miracle realised. Every new scientific discovery created in Swan a feeling of elation which was a great stimulus to further experimental effort.

At the age of eighteen Swan went to Newcastle, where, in conjunction with his friend and future brother-in-law, John Mawson, he started a chemist's business. This business ultimately became the well-known firm of Mawson and Swan. Some twenty years later, Mawson, when Sheriff of Newcastle, was accidentally killed when seeing to the disposal of a quantity of dynamite left by some miscreants in a stable. Swan at once made his widowed sister a partner in the business, thus securing to her the income she would have had if her husband had lived.

Swan patented his carbon process at the age of forty-six. This was the first patent he ever took out and was the forerunner of seventy others, the titles of which appear under his name in the Patent Office Register. The carbon process, important in itself, has had far-reaching effects upon cognate branches of photography. Employed for the purpose of producing a variable 'resist' to the action of the etching fluid in photogravure, it is the parent of that most highly refined form of photo-mechanical reproduction. Many of the carbon prints made by Swan in 1864 still exist in perfect condition, as strong in tone as when they were made.

The invention by Hermann Sprengel in 1865 of the mercury vacuum pump cleared the way for the invention of the incandescent lamp. Ten years later Crookes astonished the world by his radiometer, the construction of which demanded an almost perfect vacuum. It was Crookes's researches which spurred Swan on to invent an incandescent lamp. In December 1878, and in January and February 1879, Swan publicly exhibited his carbon incandescent lamp to large numbers of people in Newcastle, Gateshead, and Sunderland. The first incandescent lamps made by Swan were not suitable for the market, but in 1880 he devised the parchmentised cotton filaments. For several years, all the world over, incandescent lamps were made with this filament. In 1883 this filament was superseded by Swan's invention of the 'squirted' filament, made from cellulose, the efficiency of which was much higher. It was during his early experiments with the squirting process that Swan conceived the idea that the thread-like material, designed for filaments, was also capable of being used in a textile way for the manufacture of a fabric. Some of the finer cellulose threads produced in this way were crocheted by Mrs. Swan into lace and used to make the border of small mats and d'oyleys. A few of these articles were exhibited at the Inventions Exhibition of 1885, under the description 'artificial silk'. In this application lay the germ of one of the most important inventions of modern times, the artificial silk manufacture.

In 1882 the Edison Company applied for an injunction to restrain the Swan Company from making lamps. This injunction was refused, but the good sense of the directors led to the amalgamation of the two rival companies under the name of "The Edison and Swan, United Electric Light Company, Ltd."

In 1894, Swan was elected a fellow of the Royal Society. His election followed upon a communication to the Society recording the results of an elaborate research upon the electrolytic deposition of copper which he had carried out with the assistance of John Rhodin.

For eighteen years Swan experimented with filaments for incandescent lamps. In particular he experimented with refactory metals, including tungsten. He was, however, forestalled by German inventors. Baron von Welsbach, the inventor of the gas mantle, produced the osmium lamp; Messrs. Siemens and Halske, the tantalum lamp, and Just and Hanaman the tungsten filament lamp. The osram lamp was so called because it was made from an alloy of osmium and tungsten (German *Wolfram*). The tungsten filament has now practically universally superseded the carbon filament in lamp manufacture.

Swan was an intense lover of Nature. The beauty of natural forms, colours, and sounds at all times filled him with a pleasure akin to rapture. His letters abound with allusions to the sounds and sights of the country. For him all the wonders of science were of little account when matched with the grandeur of a thunderstorm or the 'heavenly alchemy' of a sunset on a summer's day.

His children in this book give an excellent portrait of his modest and unassuming personality. His habitual temper was one of considerate gentleness marked by a chivalrous courtesy which with him was a second nature. He was the soul of generosity. Those who sought his advice never failed to receive the best that he could give. He died in 1914 at the age of eighty-six years, lamented by many friends, having been fortunate to accomplish much for the welfare of humanity. A. R.

Scientific Farming in Germany.

Handbuch der Landwirtschaft. Herausgegeben von Fr. Aereboe, J. Hansen und Th. Roemer. Fünf Bände. Lieferung 8, Band 1. Pp. 129-256. 5·80 gold marks. Lieferung 9, Band 2. Pp. 385-512. 5·80 gold marks. Lieferung 10, Band 4. Pp. 129-256. 5·80 gold marks. Lieferung 11, Band 2 (Schluss); Band 3. Pp. xvi+513-564+129-160. 5·80 gold marks. (Berlin: Paul Parey, 1928.)

THERE is a story of how, invited to contribute to the literature of elephants, an Englishman described "Elephants I have shot; with an appendix on the ivory trade". A Frenchman, on the other hand, wrote an intimate biography, "Samson: the Amours of an Elephant"; but a German authority, inviting the collaboration of twenty-seven of his friends, produced six volumes of a "Handbook on Elephants in Health and Disease: their History, Life, Death, and Metaphysical Implications; with some Account of the Giraffe and the Rhinoceros". To ensure the sale of all six volumes—for it seemed possible that a specialist interested only in ivory, or in giraffes, might omit to buy the other volumes—the work was produced in some score of parts: parts contrived to include frequently the beginnings or endings of articles, rather than the complete essay, consecutiveness also being carefully avoided. Thus a student requiring the conclusion of an important article in part 3 might possibly find it in part 17.

Like all parables, this exaggerates; but in some respects, when dealing with the present instalments of the "Handbook to Farming", the reviewer began to feel that agriculture was an elephant. We have here a compilation of undoubted value, by authorities of undoubted eminence: but the method of its production is open to serious questions from the point of view of the English student. The work is not an encyclopædia or a dictionary, in the sense of an alphabetical series of articles that would lose their value unless the complete edition were obtained. It is rather a series of monographs, or text-books, covering the whole field of farming theory and practice: there can be few farmers who would buy and use the complete book, and there might be many workers interested in individual sections who would be unable to purchase all the twenty instalments of the 'Handbuch'. Since it was to be published in separate parts, one asks why the individual parts might not have coincided with complete sections of the work, in the manner, say, of Abderhalden's well-known "Handbook of Biological Methods".

Apart from this, however, the 'Handbuch' continues to fulfil its promise of providing full information about 'scientific farming', as distinguished from agricultural science. That is, many of the articles have the character of short text-books rather than monographs, and this is reflected in the fewness of the references to original work. From this point of view, illustrations, graphical or photographic, are scarce relative to the amount of print, except in one or two of the contributions.

In the instalments now to hand, Part 8 contains one complete article and parts of two others from Volume 1 of the complete edition. This volume is to deal with farm management and the economics of agriculture: almost half of Part 8 is given to the conclusion of Prof. F. Beckmann's account of various aspects of economic policy. After discussing the question of agricultural customs duties and the reactions between German and world agricultural policies, he reviews the condition of agricultural credits and mortgaging in Germany since the stabilisation of the currency; then come shorter discussions of such questions as the best working size of a farm, and the hereditary transmission of landed property. Dr. H. Zörner of Berlin makes a survey of the buildings, plant, and equipment required for different types of cultivation, and for all the varieties of live-stock farming down to rabbits, fish, and bees. Then Prof. Z. W. Ries of Bornim considers the nature and composition of farm-labourers, and the paying of their wages.

Part 9, after concluding Dr. M. v. Wrangell's article on plant nutrition (where we note a graphical

representation of Mitscherlich's views on the relationship between increasing fertilisation, yields, and profits), is devoted largely to the enemies of crops. Weeds, their classification and control, are discussed by Prof. C. Fruwirth of Vienna, who distinguishes between special methods and those that may form a part of ordinary soil treatment. Then, after a section by Prof. O. Heuser of Danzig, on catch-crops and green manures, Prof. G. Gassner of Braunschweig contributes a very comprehensive article on plant diseases of all kinds. (This contribution occupies the latter half of Part 9 and is continued in Part 11.) After a detailed analysis of the causes of disease, whether chemical, physical, or attributable to parasites from the plant or animal kingdoms, there is a discussion of the fundamentals of control. Then various methods of control are described under their appropriate groups: first those involving cultural measures—soil management, and the manuring, rotation, and after-treatment of crops; then biological control, briefly considered; specific susceptibility and the breeding of immune varieties; and the use of mechanical, physical, and chemical treatments. The dipping of seeds is fully described.

Passing from methods of control, Dr. Gassner then discusses the rusts of cereals: their classification, distribution, and development, and the influence of external factors such as climate and soil. The identification of rusts is aided by some very effective illustrations in full colour—but at present these illustrations are to be found in Part 11 of the 'Handbook'.

Volume 4 of the complete 'Handbuch' is intended to cover general questions of animal husbandry, and Part 10 contains a portion of this volume: namely, the conclusion of an account of the breeding and selection of farm animals, by Prof. C. Kronacher of Hanover, and a large but incomplete section by Prof. G. Fingerling on animal nutrition. Prof. Kronacher's article is well illustrated with photographs and charts—particularly the section on hybridisation and the application of the Mendelian law, which goes far into the theory of genetics. In Prof. Fingerling's contribution on animal nutrition, the constitution and digestion of feeding stuffs, their uptake by animals, and nutrient values are first considered. There is a brief review of vitamins, and then follows the establishment of feeding standards and maintenance rations for various classes of stock. Green fodder and hay are under detailed consideration when Part 10 ends.

The remainder of Prof. Gassner's article on plant diseases appears in Part 11; after rust control, and immunity or resistance to rusts, comes a useful review of the organisation of protective measures against plant disease in Germany. The next article in Part 11, by Dr. G. Blohm of Halle, gives a practical account of the harvesting and storage of crops; it includes an illustration of the English method of crop-drying, and other less usual methods, such as the 'souring' of beet leaves and potatoes. This concludes Volume 2 of the 'Handbuch' on arable farming, and an efficient but not exhaustive index is followed by four plates in full colours to aid in identifying weeds and rusts. The remainder of Part 11 is a section without beginning or ending, from Prof. Opitz's contribution on potato cultivation.

Malaria in the Roman Campagna.

Die Malaria in ihrer Bedeutung für die Geschichte Roms und der römischen Campagna: eine kulturhistorische Studie. Von Prof. Angelo Celli. Herausgegeben von Anna Celli-Fraentzel. Pp. vii + 118. (Leipzig: Georg Thieme, 1929.) 12 gold marks.

THIS is an abridgment of the monograph in Italian on the history of malaria in the Roman Campagna (1925) by the late Prof. Angelo Celli, and is edited by his widow. Prof. Celli gathered his evidence from an amazing variety of sources, as the references in the bibliography attest, and the result is a fully documented account of the author's assiduous and masterly investigation in this very difficult subject, which occupied the last years of his life.

A short introduction of ten pages refers to the problems in the history of the Campagna, the key to many of which is to be sought in malaria, a brief account of the organism of which and its mode of transference is given. The author directs special attention to the rhythms of malaria and states that statistical records in the second half of last century show that the high points of epidemics recurred with a ten-year frequency. He also points out that, with recent fuller knowledge of the history of malaria, a periodicity in which centuries are involved is recognisable. In the investigation of such a subject, which is of great interest not only from the biological but also from the historical point of view, Prof. Celli held that there was no place more suitable than the Roman Campagna, the varied ups and downs of which, from prehistoric times, have been studied again and again by archæologists, historians, naturalists, doctors, politicians, economists, and agriculturists.

A short section of half a dozen pages on the pre-Roman period commences with the statement that it is an open question whether in that period malaria was already prevalent in the Latin plain or whether it was introduced in historic time. In view of the high culture of the Latin and Etruscan towns, the author concludes that in the first century after the founding of Rome malaria was either absent or mild, but in the earlier period of the Republic came the decline and many of the communities of Latium disappeared, owing, as the author concludes, to malaria.

In the next section the history of the Campagna during the time of the Republic and the Empire is considered. The Romans learnt from the Etruscans to drain the swamps, and to this end the *cloaca maxima* was made to drain the swamp at the Forum, though later it became a sewer. But in spite of much labour expended on canals and drainage, malaria spread. Prof. Celli notes the record by Livy of epidemics—apparently of malignant malaria—in the Campagna in 411, 409, and 399 B.C. He does not agree with the statement of W. H. S. Jones that malaria was introduced into Rome from Carthage. He turns to the ancient writers on agriculture, the army, and public works for further evidence on the varying incidence of malaria. He argues that in the early part of the Imperial period (the first century A.D.) malaria was not important in the Campagna; had it been strongly prevalent, the Emperor and the patricians would not have exposed themselves to the air of that region in summer and autumn, nor would the catacombs, situated in the suburbs and in the Campagna, have been a suitable meeting place, for being dark and moist, cool in summer and warm in winter, they would have been an especially good haunt for *Anopheles*.

Prof. Celli points out that when Christianity became the State religion in A.D. 312, about thirteen bishoprics were founded around Rome—a sufficient index of human activity in the very region which later was depopulated by malaria. He cites some of the records, and concludes that by the middle of the fifth century the epidemic had spread in the neighbourhood of Rome, and he traces its further great development during the next century or more—for this was the second high portion of the malaria curve.

During the eighth century there was a spontaneous decline of malaria, but the disease flared up again in the tenth century and remained prevalent during the next two or three hundred years. Prof. Celli refers to the gardens of the Campagna which, about the end of the tenth century, were highly cultivated—the gardeners had their own guild. The gardens required water and the old drainage ditches were neglected, *Anopheles* bred and carried malaria, and the gardens of the Campagna went entirely to ruin. In the thirteenth century malaria extended over many parts of Italy, but was probably on the wane about the end of the fourteenth century.

From almost certain indications the gradual rise of the malaria curve in the second half of the sixteenth century can be followed, and in the first half of the seventeenth the disease became not only more frequent but also ever worse. The chief modern authorities on the Campagna are agreed that the middle and end of the seventeenth century was the period during which the decline of the Campagna was completed. The history of this epidemic—the fourth high curve—is traced up the nineteenth century.

Angelo Celli preached the crusade against malaria especially in the Campagna, and in 1898 was the principal founder of the malaria society which successfully advocated the distribution of quinine by the State, and also, of course, vigorously pressed other methods of attacking the problem, such as drainage, treatment of water, and the netting of doors and windows. He refers, however, to the possibility that the betterment may have been due to a spontaneous diminution of malaria.

This very interesting volume concludes with a bibliography of 434 references, an index of names of persons and places referred to, and a map of the Campagna.

Our Bookshelf.

(1) *Science and the Unseen World.* By Prof. Arthur Stanley Eddington. (Swarthmore Lecture, 1929.) Pp. 56. (London: George Allen and Unwin, Ltd., 1929.) 2*s.* 6*d.* net; paper, 1*s.* 6*d.* net.

(2) *The Meaning of Life: as shown in the Process of Evolution.* By C. E. M. Joad. (The Forum Series, No. 10.) Pp. iv + 60. (London: Watts and Co., 1928.) 1*s.* net.

(1) Prof. Eddington's Swarthmore lecture will be read with interest by all who watch the movements of scientific thought in relation to philosophy and religion. The attitude of the author has become generally familiar through his volume on "The Nature of the Physical World", but in the present lecture he attacks the religious problem at closer quarters. His treatment of it, as one would expect, is both original and suggestive. He puts aside the question, Does God really exist? "because it raises so many unprofitable side issues, and at the end it

scarcely reaches deep enough into religious experience. Among leading scientists to-day I think about half assert that the aether exists and the other half deny its existence; but as a matter of fact both parties mean exactly the same thing and are divided only by words." He points out that the crucial point for us is not a conviction of the *existence*, but a conviction of the *revelation*, of a supreme god. It is, if we may venture to say so, only very rarely that a man of science so well understands the true nature of the religious problem. Also, Prof. Eddington has no sympathy with any attempts "to base religion on scientific discovery" which the scientifically nebulous and the religiously fantastic have sometimes made. He knows how much to expect from science, namely, what it can tell us and what it cannot. The methods of physical science do not lead us to anything which can serve as a basis for religious experience, but only to "a shadow world of symbols". For that necessary basis we must return to our starting-point in human consciousness, the only point where we have direct and first-hand knowledge of reality.

(2) It is interesting that Mr. C. E. M. Joad, who writes rather from the point of view of biology than of physics, says much the same thing. He, too, looks to our inner conscious life for the key to the nature of things; yet even this knowledge eludes us, or at least resists description. "Life as we experience it is indescribable: knowing what it is like to be alive, we cannot yet say; we can say what life does, but not what it is." Yet life is purposive, and has now reached a point when its control over matter is almost complete; so much so that our interest in matter will tend to decrease—"having emancipated itself from the need to know matter, life's attention comes to be centred directly and continuously upon the world of value". This book is full of most interesting ideas and suggestions. J. C. H.

Perfumes, Cosmetics, and Soaps: with special reference to Synthetics. By William A. Poucher. Vol. 2: Being a Treatise on Practical Perfumery. Third edition. Pp. xiv + 521 + 45 plates. (London: Chapman and Hall, Ltd., 1929.) 25*s.* net.

THE first chapter of the new and enlarged edition contains a short historical survey of the subject, accompanied by some excellent illustrations of kohl pots and other adjuncts of the perfumer in use among the ancient Egyptians, Greeks, and Romans. A general account of the occurrence and separation of plant perfumes is followed by chapters on flower absolutes, the classification of odours, and fixation. A main feature of the book is provided by a series of some two dozen short monographs on flower perfumes: each of these contains notes on history, varieties, odour, natural perfume, chemistry, compounding, and synthetic components. Formulæ and recipes are given for a large number of miscellaneous fancy perfumes and toilet waters, and there are also informative sections on soap perfumery, tobacco flavours, floral cachous, etc. In the second part of the work the subject of cosmetics is treated in similar detail.

Mr. Poucher's book has been well planned and executed, and it will be helpful to all who are concerned with the industrial, scientific, or historical aspects of the important subject with which he deals. The general production is excellent, and the sixty-six illustrations cover a wide range of cultivated plants and technical processes and apparatus. As an example of the simple faith of our forefathers, we cannot refrain in conclusion from quoting a quaint letter written by the third Earl of Pembroke, Lord Chamberlain, to the Sheriff of Staffordshire:

"Sir, His Majesty, taking notice that the burning of Ferne doth draw down rain, and being desirous that the country and himself may enjoy fair weather as long as he remains in these parts, His Majesty has commanded me to write to you to cause all burning of Ferne to be forborne until His Majesty be past the country." J. R.

Lichtelektrische Erscheinungen. Von Prof. Bernhard Gudden. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 8.) Pp. ix + 325. (Berlin: Julius Springer, 1928.) 24 gold marks.

THE subject of photoelectricity has of late become of primary importance in physical theory. The present book is a laudable attempt to survey the whole of the complex phenomena included in that title. The author divides the phenomena into external ones, where electrons are projected outside the substance, and internal ones, where the photo-effect is confined to the interior of the substance. The former class is most familiar to physicists, and has been greatly cleared up by the verification of Einstein's quantum theory of photoelectric action. The author refers to Elster and Geitel's success in discovering single quanta by photoelectric action, and adds, "this attains the sensitiveness of the human eye". He should have said "greatly exceeds", since the human eye requires at least 200 quanta per second to perceive light.

The internal photoelectric effect is dealt with mainly from the point of view of crystals, on which the author himself has done valuable work. The chapter on selenium is a short one of fifteen pages, and is somewhat disappointing. It is practically taken from Ries's "Das Selen", published in 1918, and omits much recent work which has cleared up several obscurities. The work concludes with a brief account of certain phenomena as yet imperfectly linked up with photoelectricity, such as the Becquerel and Weigert effects.

Études sur les mouches parasites. Tome 1: *Conopides, Œstrides et Calliphorines de l'Europe occidentale; recherches sur la morphologie et la distribution géographique des Diptères à larves parasites.* Par E. Séguy. (Encyclopédie entomologique, Tome 9.) Pp. 251. (Paris: Paul Lechevalier, 1928.) 65 francs.

THIS memoir is divided into two sections. The first section is devoted to a systematic account of the species of Conopidæ found in western Europe. The second section is of a more general character

and deals with morphology, biology, and taxonomy of the Œstridæ and Calliphorinæ, which are included by the author in the family Tachinidæ. The Conopidæ are parasitic, as larvæ, on bees and wasps, and in a few cases upon Orthoptera. Very little is known of the details of the parasitism and research is greatly needed. The Œstridæ are all parasites of vertebrates, while the Calliphorinæ are of more varied habits. Their larvæ are either saprophagous or carnivorous, and are more rarely occasional or regular parasites. The biology of the groups of flies dealt with, therefore, affords unusually interesting examples of various phases of development, while many of the species concerned are of definite economic significance. We can commend the memoir as a sound and trustworthy contribution by a recognised authority on the subject. It is adequately illustrated and is accompanied by a full bibliography.

Flora of West Tropical Africa: the British West African Colonies, British Cameroons, the French and Portuguese Colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. By J. Hutchinson and Dr. J. M. Dalziel. Prepared at the Herbarium, Royal Botanic Gardens, Kew, under the Supervision of the Director. Published under the Authority of the Secretary of State for the Colonies. Vol. 1, Part 2. Pp. iii+247-523. (London: The Crown Agents for the Colonies, 1928.) 8*s*. 6*d*.

PART 2 of this work comprises 44 families from Sterculiaceæ to Umbelliferæ in the phylogenetic order devised by Mr. J. Hutchinson, one of its authors. Several families of great importance from the botanical as well as the economic point of view are included, such as the Malvaceæ, Euphorbiaceæ, Leguminosæ (here divided into three families), Meliaceæ, Anacardiaceæ, and Umbelliferæ. The one represented by the most abundant species is of course the Papilionaceæ, which occupies just one-fifth of the whole part (the 'Leguminosæ' take up three-eighths). Next in order come the Euphorbiaceæ with one-seventh. There are sixty-nine excellent full-page and text illustrations, drawn by W. E. Trevithick, which materially assist in the determination of the plants represented and in the understanding of the chief characteristics of the families to which they belong. C. FISCHER.

Evaporating, Condensing and Cooling Apparatus: Explanation, Formulæ and Tables for Use in Practice. By E. Hausbrand. Translated from the second revised German edition by A. C. Wright. Fourth English edition revised and enlarged by Basil Heastie. Pp. 468. (London: Ernest Benn, Ltd., 1929.) 25*s*. net.

HAUSBRAND'S work, the first English edition of which appeared in 1903, has long been recognised as an authority on the subject. It sets before the engineer, in a readily applicable form, the results of experiments in physics and of large-scale plant processes, and contains a number of valuable tables. In the present edition, the work carried out in the National Physical Laboratory in 1916, which confirmed the earlier investigations of Osborne Reynolds on fluid flow, is taken into account. It supersedes the empirical results which were previously the only ones available, and large changes have been made in the sections and tables dealing with this part of the subject. The experiments on heat losses by radiation and convection, also made in the National Physical Laboratory in 1923, have been dealt with by the reviser, and a chapter has been added on modern evaporating plants. These and other alterations have considerably improved the work, and the English translation is therefore much in advance of the German edition. When the great amount of valuable information in the book is considered, the price must be regarded as moderate.

From a Bird-Lover's Diary. By Arthur Astley. Pp. ix+306+8 plates. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1928.) 7*s*. 6*d*. net.

THIS little volume gives us the results of the author's observations on birds in a northern district of England. He divides his chapters into those containing the birds of lakeland, those of woodland, and those of the mountains, after which he devotes a chapter dealing with bird life month by month as he finds it to be within these areas, selecting certain birds as emblematical of each individual month. The author calls his book a diary, and, perhaps, it has lost some of its charm by his keeping too carefully to the form which its title indicates. We confess we should have liked less diary—entailing a good deal of overlapping—and more information and anecdote about the birds and their habits. In spite of this, though we are told nothing that is new, there is much that is of interest, whilst the book is easy to read and holds one's attention throughout. The photographs with which the book is illustrated are very charming, and have been well selected with the view of giving as varied suggestions as possible of the haunts of the birds discussed.

Power Resources of the World (*Potential and Developed*). Compiled by Hugh Quigley for International Executive Council, World Power Conference. Pp. xii+170. (London: World Power Conference, 1929.) 21*s*.

THE assessment of the power resources of the world presents formidable difficulties, if only on account of gaps in precise figures from many countries. The lack of a standard method of investigation and a common basis of evaluation are other drawbacks to reaching satisfactory conclusions. In this volume, however, an attempt has been made, and apparently with considerable success, to assess the world's power resources in coal, oil, and water. Inexhaustible sources of power, such as wind, tide, and solar energy, and also timber, do not come under review. Their use depends partly on inventions and, in the case of timber, on man's will to increase the supplies. The book concludes with a chapter on world power production on a common basis, and a lengthy bibliography covering works published since 1924 on power resources.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Biology of Lakes in Kenya.

WESENBURG-LUND, Thienemann, and others have for years been emphasising the need for more detailed studies of tropical fresh waters. Having recently been enabled, through the help of the British Association and the Percy Sladen Memorial Trust, to make a short investigation of some lakes in the Rift Valley in Kenya, I may summarise here some of my observations.

FIG. 1.—Lake Nakuru, with flying flamingoes.

Lake Baringo, lying just to the north of the equator at an altitude of 3000 feet, was visited once, while Lakes Nakuru, Elmenteita, and Naivasha, and a small crater lake lying about 2° to the south, at an altitude of more than 6000 feet, were examined more fully.

The temperature conditions found at the higher altitude approached those of temperate regions, but diurnal changes were more marked, complete inversion occurring in the shallower waters, as shown below :

Depth.	7 A.M.	9.30 A.M.	Noon.
0·5 m.	18·2° C.	18·5° C.	21·5° C.
1·5 m.	18·6	18·5	20·0

Lake Naivasha was the least abnormal and perhaps approached most nearly the 'oligotrophic' type. It contained planktonic Entomostraca and Rotifera, of which quantitative hauls taken at a number of depths showed concentration in the lower layers by day. The phytoplankton contained a species of *Microcystis* and various diatoms, while successive zones of aquatic plants, such as *Potamogeton* sp. and *Myriophyllum* sp., extended more than half a mile from the shore and sheltered an abundant fauna. Fish, recently introduced, were numerous, and bird-life was rich and varied.

The alkali reserve of Lake Naivasha, expressed in normality, was 0·004 (cf. Cambridge tap water 0·0042 *N.*), but instead of calcium, as in English hard waters, the base was sodium derived from the surrounding alkaline lavas. This may have had a specific effect, as in increasing concentrations the alkalinity appeared to effect a marked reduction in quantity of both fauna and flora. The other lakes illustrated this, since their alkalinity increased in the order : L. Baringo (0·01 *N.*), Crater Lake (0·11 *N.*), L. Elmenteita (0·22 *N.*), and L. Nakuru (0·27 *N.*). This increase raised the hydrogen ion concentration from *p*H 9·0 to about *p*H 11·2. Lake Baringo contained Crustacea, Rotifera, insect larvæ, and fish, and also *Microcystis* sp., but no higher plants were seen. The three others, 'soda' lakes, contained chiefly Rotifera and insect larvæ, Lake Nakuru having apparently only one species of *Brachionus*. They were further characterised by the presence of a very abundant blue-green alga, *Spirulina* sp., in the plankton and an entire absence of shore vegetation, which was replaced by foul, barren mud, largely admixed with flamingo excreta.

On these 'soda' lakes there are two classes of birds. The first are occasional visitors only, such as pelicans, gulls, and ducks ; the second and most important are the flamingoes (Fig. 1), of which vast flocks formed a striking pink border to the green water. Examination in May of some flamingoes' stomach-contents showed them to have been feeding almost entirely on the *Spirulina*. Whether or not this association persists throughout the year cannot be stated, but these microphagous birds must always be dependent upon some such 'water-bloom' as that observed, and they must play an important part in the bionomics of these lakes. It may be tentatively suggested that diatoms, although comparatively scarce at the time of the investigation, may be sufficiently abundant at other times of the year to form their staple food.

FIG. 2.—Lake Baringo. The shore is barren, but the Marabou stork, which comes to fish, can be seen.

PENELOPE M. JENKIN.

Department of Zoology,
University, Birmingham.

Fused Paramagnetic Salts.

ABOUT a year ago I reported measurements on a class of 'polynuclear' organic salts of iron and chromium which obeyed the law $\chi_a(T-\theta)=C$ with very large negative values of θ of the order -600 for the iron salts and -100 for those of chromium (*Phil. Mag.*, **6**, 481; 1928; and *Phys. Rev.*, **32**, 320; 1928). The suggestion was made that negative θ was a measure of a certain control by or coupling with neighbouring organic groups which opposed the orientation of the metallic ions considered as the elementary magnets. For these particular salts the control was imagined to be due to the electric dipole character of the organic groups.

Negative values of θ are, however, of general occurrence in salts in the solid state, and appear when we have no reason to believe that the anions are electric dipoles. In order to retain the hypothesis of control or coupling, it is desirable to ascribe it more generally to the forces which determine the crystalline state. It was with this in mind that I planned the present measurements of the susceptibilities of some paramagnetic salts throughout a range of temperatures including the melting point. It seemed possible that θ might change at the melting point and in the sense required by the interpretation under discussion: namely, diminished control in the liquid state should give $\Delta\theta > 0$.

The salts chosen were the hydrated salts which melt at low temperatures, avoiding danger of decomposition although not entirely excluding the possibility of more subtle chemical complications. They were used as powders packed in glass bulbs of about 0·6 cm.³ capacity through a capillary long enough so that the bulbs could be sealed off without melting any of the salt. The measurements were made with a torsion balance of the Terry type (*Phys. Rev.*, **9**, 394; 1917). The water-cooled magnet had pole faces of 10 cm. diameter, and the gaps were 6 cm. or more. With such large gaps, $\int H\frac{dH}{dx}dv$ was sensibly constant over the volume of the bulb, so that there was no error due to redistribution of the material when it melted. An electric furnace served as heater. The usual corrections for container, diamagnetism, and emergent thermometer stem were applied. The air corrections were negligible. $FeNH_4(SO_4)_2+12H_2O$ was used as a standard with $\chi=+30{\cdot}1\times10^{-6}$ at 20° C. All the salts were analysed for water of crystallisation.

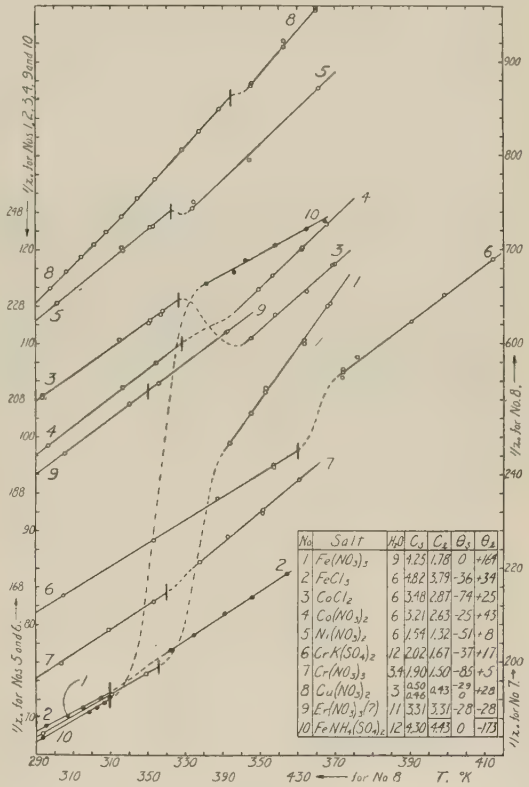
The results are shown in Fig. 1, in which is included a table of the observed constants C_s, C_l, θ_s, and θ_l, where the subscript s and l refer to the solid and liquid states respectively. The melting points are indicated by short vertical bars across the curves. The results are reproducible. The curves shown represent the second run on each of the salts except $FeNH_4(SO_4)_2+12H_2O$. Only one curve was taken for the latter salt, as it is of the same form as that obtained by Honda and Ishiwara (*Sci. Rep. Tôhoku*, **4**, 215; 1915) for the same temperature limits.

We see that for all of the first eight salts θ changed in the sense anticipated, $\Delta\theta=\theta_l-\theta_s>0$, and that the change is sometimes surprisingly large. Fusion is generally accompanied by a change in the Curie constant as well. For these eight salts this constant always decreased.

$Er(NO_3)_3+11H_2O$ (?) is the only exception to the rule $\Delta\theta>0$ on fusion. Perhaps the rule $\Delta\theta=0$ applies to all rare earth salts since their paramagnetism originates in the deeper energy levels not directly involved in chemical valence and crystalline structure. It should be mentioned that while this salt was labelled erbium nitrate it was, apparently, not pure. The Curie constant for the erbium ion should be about 11·2. It is probable that the salt was a mixture of salts of the so-called yttrium group. However, it seems safe to assume that it was a mixture of nitrates of the rare earths only.

The exception in the case of $FeNH_4(SO_4)_2+12H_2O$ is only apparent. This salt did not really fuse at all. In a separate experiment, in which the changes with increased temperature could be directly observed, it was found that a precipitate formed on passing the nominal melting point 37° C. Beyond 62° C. (335° K.), where the curve is linear again, the precipitate had settled to the bottom of the clear solution.

It became evident early during the course of the work that melting-point data for hydrated salts must be used with caution. When fusion really occurs the melting point is not usually in agreement with the tabulated values. A more serious source of error



No.	Salt	H_2O	C_s	C_l	θ_s	θ_l
1	$Fe(NO_3)_3$	9	4·25	1·78	0	+169
2	$FeCl_3$	6	4·82	3·79	-36	+34
3	$CoCl_2$	6	3·48	2·87	-74	+25
4	$Co(NO_3)_2$	6	3·21	2·63	-25	+45
5	$Ni(NO_3)_2$	6	1·54	1·32	-51	+8
6	$CrK(SO_4)_2$	12	2·02	1·67	-37	+17
7	$Cr(NO_3)_3$	3·4	1·90	1·50	-85	+5
8	$Cu(NO_3)_2$	3	0·50 0·98	0·43	-29 0	+28
9	$Er(NO_3)_3$ (?)	11	3·31	3·31	-28	-28
10	$FeNH_4(SO_4)_2$	12	4·30	4·43	0	-173

FIG. 1.

may arise from the fact that some salts do not actually fuse. For example, the salts $MnCl_2+4H_2O$ and $NiSO_4+7H_2O$, which are supposed to melt at 87° C. and 99° C. respectively, merely coalesced at those temperatures as if the particles had become wet. They did not flow in the sealed containers even at 150° C.

Fused hydrated salts may, of course, be regarded as solutions in their own water of crystallisation. This point of view is, no doubt, more consistent with the observation that $Fe(NO_3)_3+9H_2O$, $FeCl_3+6H_2O$, $CrK(SO_4)_2+12H_2O$, and $Cr(NO_3)_3+3{\cdot}4H_2O$, when once fused, do not solidify on cooling to room temperature. It is scarcely worth while to compare the present data with previous work on solutions because of the vast differences in concentration.

Finally, it should be stated that considerations similar to the foregoing have been applied by Honda (*Sci. Rep. Tôhoku*, **3**, 171; 1914) and by Kunz (*Phys.*

Rev., **6**, 113; 1915) to account for the term $\chi_a\theta$ in the law $\chi_a(T-\theta)=C$.

This work is due in part to Prof. E. P. Adams, who suggested that fused salts in general might profitably be studied.

LARS A. WELO.

Princeton, N.J.,
July 31.

Recession and Age of the Tahitian Coral Reefs.

I HAVE further facts to offer in support of the contention that the reefs of Tahiti, in spite of their abundant corals, are no longer growing, but receding, a subject to which I directed attention in NATURE of Oct. 29, 1927, p. 618.

It is characteristic of the ocean slopes of the barrier reef to be covered with rounded lumps of nullipores, as in the case of many other reefs. On my former visit I noticed that, on certain sections of the barrier, these projections have the shape, and largely the colour, of eroded coral rock, rather than of growing nullipores, but, as the outer slope is very rarely accessible owing to the surf, I did not obtain samples. Here, on the Pa'ea section, the whole surface is covered by a vigorous growth of nullipores, samples

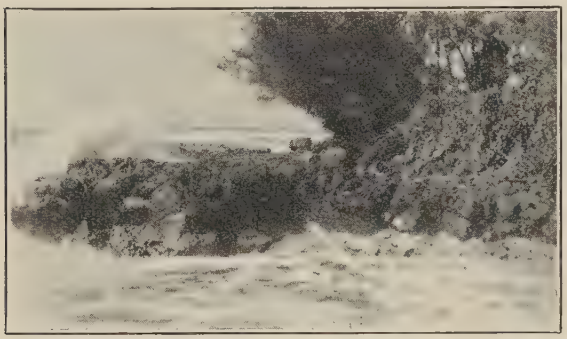


FIG. 1.—The shelf below the cliffs of the east coast of Tahiti, below which is a stratum of coral limestone, exposed only on the retreat of a wave.

of which I have obtained on those occasions when the surf has been exceptionally low. To my surprise, many specimens were detached with much difficulty, even with a heavy crowbar and sledge hammer. These specimens turned out to be a mere crust of Lithothamnioneæ growing over a core of hard coral rock, and this rock is a breccia of broken pieces of coral, Lithothamnioneæ, millepora, coarse and fine sands, shells and echinoderm spines, firmly cemented together by redeposition of calcium carbonate. Now it is evident that such small loose material could collect, and be solidified, only in hollows, and not even there unless very deep, or under several fathoms of water, and the fact that it now appears as projecting points affords direct and decisive proof that this apparently growing reef has undergone erosion; as usual, the finer filling material is more resistant and remains when the whole corals surrounding it have disappeared.

It is to be noted, too, that the destructive action of boring organisms goes on actively beneath the living crust; there is, in all cases, a band, a centimetre or so wide, surrounding each section of rock, which has been thoroughly riddled. The protective effect of an organic coating to rocks is clearly not so perfect as I have hitherto supposed.

That a coating of actively growing Lithothamnioneæ should add nothing to the reef need cause no surprise; many coasts are covered to the last inch with such a living crust, such as the Mediterranean, Cape Verde Islands, and the Marquesas (in the latter cases often with the co-operation of *Vermetus*, the tubular shells of which add not only bulk but also tenacity), but there is no reef formation.

Coral growth was abundant around Tahiti when lava was still pouring into the sea, and parasitic cones were in eruption on its shores, while the cutting of the cliffs was in progress, and, presumably, the outpouring of alluvium by streams at its maximum. This is shown by the fact that a stratum of coral breccia passes under the basaltic shore shelf at the base of the rejuvenated cliffs of the east coast. This breccia is a fine-grained rock, and is similar to that which forms the surface of the high level coral flats of this coast. Dr. Howell Williams, who has recently made the much-needed geological examination of the island, allows me to mention his discovery of several parasitic cones along the shore, besides those of Taharaa Head and Tataa Point mentioned by Davis. In two cases the tuff has carried up coral fragments, all of which are small, and may indicate eruption through a breach rather than through a reef. It will be interesting to know whether they are species still forming part of the Tahitian fauna; they are all recent, but it is possible that the fauna of Tahiti has been impoverished in recent times. In two cases the lagoon passes almost through the site of the vent of the original cone, a fact difficult to explain on any of the usual theories of lagoon formation. Moreover, the barrier reef sweeps uninterruptedly by the denuded cones; there is no bulge corresponding to their original outlines.

In the *Geographical Journal* of June 1928 I described the disappearance of several of the reef islets. *Bulletin* No. 48 of the Honolulu Museum, in an account of the districts of Tahiti given by native chiefs to the Rev. J. Orsmond between 1820 and 1840, names three islets off Point Venus, of which one alone remains, and two near Papeete, of which the eastern, named Broken Coral Island, has left no trace, while the remnant of the western, Motu Uta, is the ornament of Papeete Harbour. This account also confirms the statements given to me by natives of the former existence of islets where are now only small sandbanks.

CYRIL CROSSLAND.

Pa'ea, Tahiti,
Aug. 18.

Universities' Library for Central Europe.

THE Universities' Library for Central Europe (established in 1921 in co-operation with the Universities' Relief Committee) works to co-ordinate and consolidate the securing by gifts, exchange and purchase, British books, journals, etc., for students, professors, and libraries in the universities of Central Europe. During the last few weeks a box of English books (all presented) was sent to the University of Debrecen, Hungary, where there is a marked lack of English literature. Recently, too, an attempt was made to complete the files of NATURE as preserved by the Fondation Universitaire of Brussels, and a number of back numbers were collected from various friends in Great Britain. Many foreign universities also still purchase their English books through the medium of the Universities' Library for Central Europe, and during the present year consignments have been sent to Austria, Belgium, France, Germany, and Hungary. A large collection of books received recently from various donors has been listed, and the lists sent to the appropriate centre of the countries mentioned in order that their wants may be ascertained.

It is obvious that the work of the Universities' Library for Central Europe is continuing steadily. The wells of charity, however, seem to have ceased functioning, so far as this society is concerned, except for the regular support received from the Student Christian Movement (formerly £50, this year and last year only £20) and from the Buxton Trust (this year and last year £10). This is all the more unfortunate in view of the fact that since 1924 this society has undertaken the distribution of exchange literature received from the international exchange offices in Belgium, Hungary, and Italy. This work is proving an increasing charge upon the society's limited funds. Although as many parcels as possible are sent carriage forward, this is often an unsatisfactory procedure, seeing that the recipient institution more often than not pays postage on exchange copies of its own literature sent abroad.

The ideal would be for all institutions in Great Britain which have exchange literature to send it to the Universities' Library for Central Europe for distribution abroad, in the same way as the international offices above mentioned collect and dispatch consignments of literature in their respective countries. At the present time the only institutions in Great Britain which make use of our outward services in this respect are the British Museum (Natural History), the Royal Society of Edinburgh, and the University of Leeds. This year we have already received and distributed 1138 parcels from abroad (consignments are now, in addition, being received from the International Exchange Office in the Netherlands), and have sent out 283 parcels for the British institutions above mentioned.

This work will certainly develop, and it should be possible for this society to carry out all the international exchange business of Great Britain. To do this more and more regular funds are requisite. All possible economy is practised and a large proportion of the work is carried out with voluntary assistance ; thanks to the generosity of Sir William Beveridge, offices are supplied rent-free in the London School of Economics —but, despite all economy, transport charges on international exchange literature are fast eating up our meagre funds. Abroad, the international exchange offices are government departments : the same arrangement would perhaps not be welcome in Great Britain, but a regular government grant would enable this work to be carried out more comprehensively and satisfactorily than is at present possible. An annual grant of £500–£1000 (to mention an approximate minimum and maximum) would guarantee the execution of all the detail of this international exchange business. Such a grant would also strengthen the position of this society in carrying out its other aims, foremost among which stands the propagation of English culture. Here can be appropriately quoted the concluding words of the Executive Committee's report in 1925 :

"There is a certain demand for English books in every country in Europe, and letters are often received indicative of a desire for knowledge of English culture and ideals, language, literature, and method of government. Given adequate financial means (an enormous sum would not be required), a great work might be accomplished along these lines, with possibly far-reaching beneficial, civilising, and stabilising effects. The gifts themselves, and the manner of giving, must awaken and stimulate only a spirit of toleration and common intellectual advancement."

C. Fuller
(Hon. Secretary).
Universities' Library for Central Europe,
London School of Economics, W.C.2.

Wild Birds and Butterflies.

Prof. MacBride and I entirely disagree on the subject of natural selection and the validity of Darwin's metaphor, and I leave the subject at that all the more willingly because his letter has been, in my opinion, fully answered by Dr. G. D. H. Carpenter and Prof. W. Garstang.

The relation of birds to butterflies is so large a subject that I can only attempt to indicate certain essential points which are not touched upon by Dr. W. E. Collinge in his letter in Nature of Aug. 31 (p. 334). I may also remark that I did not fail, as Prof. MacBride asserts (Nature, Aug. 10, p. 225), to notice his words 'serious attack', and he might have seen that I even quoted them in my reply (Nature, June 8, p. 874).

(1) *The Examination of Birds' Stomachs.*—Dr. Collinge does not mention the investigations of Lamborn and Swynnerton, which prove that Lepidoptera are so quickly reduced to minute fragments in the bird's digestive tract that a careful examination under the compound microscope is required before it can be asserted that such remains are absent. Lamborn wrote of a bird which he had shot : "though . . . seen to eat two butterflies barely two hours previously, I could recognise no portions of them except with the aid of a microscope" (*Proc. Ent. Soc. Lond.*, 1920, p. xxvi). In how many of the "100,000 post-mortem examinations" referred to by Dr. Collinge has such a careful examination been made ?

(2) *Injured Wings as Evidence of Attack.*—The suggestion conveyed by the question-begging words used by Prof. MacBride (l.c.) when he speaks of "the jealously guarded treasure of butterfly wings which Prof. Poulton has collected after a search of many years", is entirely devoid of foundation. Such evidence is extremely common, as any observant naturalist will find if he looks for it. Furthermore, the shape and situation of many injuries are characteristic, and resemble those caused by observed attacks. Oftentimes the unmistakeable imprint of a bird's beak remains on the wing.

(3) *The Value of Negative Evidence.*—An example will serve to indicate the value of the negative evidence sometimes confidently brought forward by naturalists who have not made the relation of birds to butterflies the subject of specially directed observations. I may also add that the keener such a naturalist is the less likely is he to make them, because his faculties are all the more certain to be otherwise engaged.

The *Danainæ* are the commonest and most conspicuous butterflies of the Old World tropics. The males of the great majority bear scent-pockets or scent-patches on the hind wings, and from these the scent-brushes at the extremity of the body are charged and then used in courtship. (It may be remarked here, as bearing on Dr. Collinge's letter, that the epigamic scents of male butterflies which are presumably pleasant, or at any rate stimulative to their females, are also pleasant to man. Furthermore, many of the other presumably aposematic scents common to male and female butterflies of certain species are unpleasant to man. The subject is too large to deal with adequately on the present occasion, but it must be mentioned that there is remarkable unanimity in the treatment of conspicuous insects by insect-eaters of diverse groups.)

To return to the male Danaines, which certainly perform their toilet and emit the scent in courtship many times in their lives. We may safely infer this from the fact that males of all ages, as shown by their condition, may be found *in coitu*. Well, so far as I am aware, W. A. Lamborn is the only naturalist who has

seen the brushes charged with scent, but he has recorded it in two African and one Oriental species. The behaviour was observed when the butterflies were freely exposed at rest on leaves and in one instance, *Amauris niavius dominicanus*, he was able to approach sufficiently close to smell the scent, which he describes as resembling 'an aromatic snuff'. Furthermore, the subsequent use of the brushes in courtship has only been recorded by a single naturalist, Dr. G. D. H. Carpenter, who observed it in two African species, the males of which performed these epigamic functions on the wing in full sunlight, the expanded brushes being conspicuous even at a little distance. Why have not these observations been made again and again? For the twofold reason that attention has been concentrated elsewhere while this subject has been neglected. Negative evidence, here proved to be valueless, is, I believe, also valueless when it is offered in support of the conclusion that butterflies are not seriously attacked by birds.

EDWARD B. POULTON.

University Museum, Oxford,
Sept. 26.

An Iodine Liberator from Laminariæ.

THE letter of Prof. Thomas Dillon in NATURE of Feb. 2, p. 161, on this subject has suggested to us that the following preliminary report may be of general interest. Our observations being a part of the thesis for the doctorate of Karl Closs, will be published in detail later.

In carrying out experiments on the chemical nature of the iodine-containing compound in *Laminaria digitata*, we observed that iodine was liberated by acidifying the aqueous extract of the *Laminaria*. Sulphuric, hydrochloric, nitric, and acetic acids cause liberation of iodine in the same way. The *p*H of the extract must fall below a certain value before iodine liberation takes place. The *p*H of the fresh extract is about 4. After evaporating to dryness and redissolving, no iodine liberation takes place on acidifying. By adding potash to the extract when evaporating the 'iodine liberator' is preserved. Boiling with base is also without effect. The 'iodine liberator' is therefore not an iodide oxydase, as observed in the cellular liquid of Rhodophyceæ (O. Gertz, *Biochem. Ztschr.*, **169**, 435; 1926). When the iodine which is liberated by acidifying the *Laminaria* extract is extracted with chloroform, another smaller portion of iodine may be liberated by adding potassium nitrite. On the other hand, the acidified extract, after the extraction of liberated iodine and before nitrite is added, liberates iodine from potassium iodide, as also observed by Prof. Dillon.

We evaporated the original extract with potash on a water bath to dryness and extracted ten times with ethyl alcohol. The iodine-containing substance and the 'iodine liberator' are both soluble in alcohol. After adding potash the ethyl alcoholic extract was evaporated to dryness and the residue extracted 10-15 times with amyl alcohol. The iodine-containing substance is dissolved in the amyl alcohol and the 'iodine liberator' is left in the residue. The iodine liberator is not potassium iodate as is suggested by H. D. Kay in NATURE of Mar. 2, p. 317; 1929.

From our experiments we arrive at the following conclusions: The chief part of the iodine in the fresh aqueous extract of *Laminaria digitata* is present in such a form that the iodine is liberated by an 'iodine liberator', which is also present in the extract and only acts in acid solution. We do not agree with Prof. Dillon when he finds in this process an explanation for the concentration of iodine of the sea water by marine algæ, the iodine which can be liberated being present in a much higher concentration in the *Laminaria* extract than in the sea water.

Our experiments on this subject are being continued.

GULBRAND LUNDE.
KARL CLOSS.

Research Laboratory of the Norwegian Canning Industry,
Stavanger, Sept. 12.

Dew: Does it Rise or Fall?

MESSRS. E. E. FREE and Travis Hoke say dew rises; Sir Herbert Maxwell (NATURE, Sept. 14, p. 412) says it falls; Dr. J. B. Cohen (NATURE, Sept. 28, p. 482) says it does both; may I add that it does neither?

The physics of dew formation is really very simple, although much has been written on the subject and there is still much misapprehension. On a clear night all bodies radiate more heat than they receive by radiation; and so does the air near the ground. There is therefore a general fall of temperature. If the temperature of the air falls below its dew point mist or fog appears. The fall of temperature of the air, however, is frequently not sufficient for the air itself to reach the dew point; but the temperature of grass and other bodies not in good thermal contact with the ground, falling more rapidly than that of the air, goes well below the dew point. Water then condenses out of the surrounding air directly on to the cold body and dew appears on its surface. The dew is nowhere until it appears on the surface; it therefore neither rises nor falls.

Both Sir Herbert Maxwell and Dr. Cohen speak of the water vapour first condensing in the air before appearing as dew. But if the water condenses in the air there is a mist or fog, and water deposited from mist or fog is not real dew. It is true that we have no word to describe the water deposited in this way and we make the word dew serve in this case also; but a physical process is involved different from that of true dew formation. When the temperature of the air is below the freezing point and the products of condensation appear as ice we do use two different words; for hoar frost is true frozen dew, while rime is the deposit from the water which has been first condensed in the air as mist or fog.

The essential of dew formation is that the temperature of solid bodies falls by radiation below the dew point and in consequence water is deposited by direct condensation from the air on to the surface of those bodies. Where the water deposited as dew comes from is an entirely different matter, and has nothing to do with the formation of dew.

G. C. SIMPSON.

Meteorological Office,
London, Sept. 28.

A Chromosome Ring in *Pisum*.

AMONG the descendants of crosses between an individual belonging to a race of *Pisum* cultivated in Tibet and some of our own edible varieties of peas, sterility affecting about 50 per cent of the ovules and pollen grains has been observed by Miss C. Pellew to occur frequently. From other crosses of the same description but with different individuals of the Tibetan variety, the progeny were all fertile. One of the sterile plants (F_2), self-fertilised, gave a family consisting of fertile and 'sterile' plants again showing 50 per cent gametic sterility. The recurrence of gametic sterility pointed to an abnormality in the reduction divisions, and accordingly Miss Pellew

asked me to make a cytological examination of the material.

Good preparations of flower buds were obtained by using Carnoy's fixative followed by the fixative of La Cour (Nature, July 27, 1929, p. 127) and Newton's gentian violet method. In one of the sterile plants examined, a ring of four chromosomes was found to occur regularly at the heterotypic division of the pollen-mother-cells. The two pairs (*AA'* and *BB'*) can be distinguished with comparative ease. In Fig. 1 (*b*) and (*c*) indicates the alternative ways in

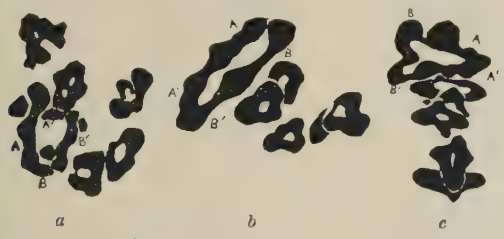


Fig. 1.—Camera lucida drawings of a chromosome ring in *Pisum sativum*. Magnification about 2500 diameters.

which chromosome separation may take place. It is suggested that the method illustrated in (*c*), in which two homologous chromosomes (of the ring) go to each pole, will give rise to non-viable gametes, whereas that shown in (*b*) will give rise to viable gametes. If the two methods of separation occur equally often, the ring formation may account for the 50 per cent sterility observed in many of the plants in this family.

I have examined several other strains of peas, and in all I have found the chromosomes arranged in seven pairs, as is characteristic of the species. Håkansson (*Hereditas*, **12**, 1929) has, however, observed the formation of a ring of four chromosomes in the experimental material of Dr. Hammerlund, in which two factors, usually independent, were found to be linked.

Eva Richardson.

John Innes Horticultural Institution,
London, S.W.19, Aug. 27.

Planaria alpina in Lithuania.

Planaria alpina has been considered as very limited in its distribution and has played an important part in the theoretical discussions of the preglacial and the postglacial fauna of Europe. It has been reported from England, from various parts of southern Europe, from Scandinavia (cf. A. Thienemann, "*Planaria alpina* auf Rügen und die Eiszeit", *Jahresb. Geogr. Ges. Greifswald.*, **10**; 1906), and recently from Finland (A. Luther). It appears that this animal, with the notable exception of Finland, has not been found east of the Baltic Sea. It has never been reported from Prussia, from the Baltic States, or from the adjacent parts of Russia. Dr. A. Luther considers that specimens found in Finland show a relationship with Scandinavia, that is, with the countries west of the Baltic rather than those of the east. I have found *Planaria alpina*, however, on the eastern coast of the Baltic as well.

While investigating the planarian fauna in the springs of Eiguliai, some four or five kilometres north of Kaunas, early last June, I found a single specimen which on close examination proved to be *Planaria alpina*. After repeated visits to the same place I was able to confirm my findings, and up to this time I have collected seven specimens. The animal is rather rare, and the specimens are quite small, none of them being longer than 9 mm. when fully extended alive. Some of the specimens show recent fission, and none of them are sexually mature.

P. alpina in Lithuania is restricted to permanent springs where the annual changes of the water temperature are a minimum. Repeated attempts have been made to find them in a creek nearby, which is fed by the same springs, and so far not a single one has been found there.

My conclusion is that *P. alpina* is more widely distributed than it is generally supposed to be. I am sure that sooner or later it should be found in other Baltic States and in the western part of Russia, that is, in the region connecting Finland and Lithuania.

P. B. Sivickis.

Universitetas, Kaunas,
Lithuania.

Cosmic Rays and Cancer.

In a letter appearing in Nature of June 29, I suggested that change in the intensity of cosmic radiations might have influenced the incidence of malignant disease.

Millikan found that at high altitudes the effective intensity of these rays was many times as great as at sea-level. As a source of ionisation, these rays possess a power of penetration unequalled by any other known.

I suggest the desirability of direct experiments to ascertain whether at high altitudes appreciable effects would ensue in the progress of malignant disease or on its primary development. In such experiments—which must of course be differential in character—similarity in the factors of temperature and atmospheric pressure at greatly differing altitudes would be easily attained without notable influence on the penetrating rays.

Consequences of grave practical importance might arise out of such experiments. At any rate they must throw some light on a very obscure and important subject.

J. Joly.

Trinity College, Dublin,
June 27.

Probable Origin of the Cold Wave in India, February 1929.

During the period Jan. 28–Feb. 3, 1929, an intense cold wave overran the whole of the north-west and centre of India, where surface temperature went down to about 12° C. below normal, several stations recording the lowest temperature in the last four or five decades. The results of a few soundings over Agra, which reached the stratosphere during and after the passage of the cold wave, appear to throw some light on the origin of the cold air. During winter the normal height of the tropopause over Agra (Lat. 27°) is about 14·5 gkm. and its temperature is 206° A. (see Dr. Ramanathan's Fig. 1, Nature, June 1, p. 834), while with the invasion of the cold wave the base of the Agra stratosphere came down so low as 11·5 gkm. and its temperature rose to 213° A. The conditions in the troposphere and the stratosphere over Agra during the cold wave were similar to those normally found at about Lat. 40°. The trajectories of pilot-balloon flights up to 6 km. indicate that the cold air came from the north-west. It would thus appear that the cold wave had its origin somewhere to the east of the Caspian Sea.

S. C. Roy.
G. Chatterji.

Meteorological Department,
Poona.

The Movements of Flame in Carbonic Oxide–Oxygen Explosions.

RECENT WORK AT SOUTH KENSINGTON.

By Prof. HAROLD B. DIXON, F.R.S.

IF the highest reward a teacher can reach is to start a school which will carry on his lines of research, improving his technique, extending his data and enlarging his horizon, I may well claim that my lines have fallen on pleasant and fruitful places. This reflection is not a new one, for I have had many students who have extended and improved on my experiments, but it is brought vividly to mind by the appearance of a memoir by my old pupil and colleague, Prof. W. A. Bone, in conjunction with Dr. R. P. Fraser, on the photographic analysis of carbonic oxide explosion-flames (*Phil. Trans.*, A, **228**; 1929).

It is more than fifty years ago since the observation was made (at Oxford) that an electric spark, which would fire 'knall-gas' (a mixture of two volumes of carbonic oxide with one volume of oxygen—$2CO + O_2$) in a moist eudiometer, failed to cause an explosion when the gases and vessel were dried. The experiment was tried because in repeating Bunsen's work on the division of oxygen between an excess of carbonic oxide and hydrogen, I had found that the steam readily oxidised carbonic oxide at flame temperatures leaving free hydrogen. The moisture present in Bunsen's experiments must have taken part in the change, and the amount of carbon dioxide formed depended not only on the relative affinity between carbonic oxide and oxygen, but also on the quantity of steam present.

Since carbonic oxide was oxidised apparently by water, and not directly by oxygen, an attempt was made to measure the rate of the knall-gas flame along a tube when different amounts of steam were present. I can well remember how I first tried to do this by photographing the explosion flame with a camera swung on a long pendulum in front of a coiled lead pipe with glass end-pieces which were brought vertically one above the other.

The camera, as it swung, broke a circuit and fired the gases at one end of the coil: the object was to record the two flashes at either end of the coil on the plate as it was moving with a known velocity. The passage of the flame appeared to be instantaneous, but the explosion was so violent that the glass-piece at the farther end was shattered and the camera put out of action. This was in 1881: just afterwards came the discovery of *l'onde explosive* by Berthelot, and the photographs of the 'uniform' and 'vibratory' movements by Le Chatelier. Some years later (in 1895) my students at Manchester and I made the first spinning-wheel camera to study explosion-flames—especially those of cyanogen. I remember how we were warned that the wheel would probably fly to bits, and that the film attached to the wheel would certainly break off. Neither of these things happened; and from this crude rotating-film has descended a line of machines which has now culminated in the beautiful high-speed camera of Dr. Fraser's described in this memoir.

The most novel feature in this camera is the method of driving the rotating drum by contact between a small friction-wheel and the spherical surface of a phosphor-bronze driving-wheel attached to the motor. The friction-wheel is built up of two steel plates clasping a disc of compressed leather, the surface of which is machined at such an angle that only a narrow rim of it is actually touching the driving wheel. The latter (with its motor) is fastened to a turn-table which can be moved to make contact with the friction-wheel at any point in a line from the centre of the spherical surface to its outer edge. The gear ratio between the motor and the drum can thus be varied from one infinitely small up to a ratio of 4·5 to 1; and any constant speed between 30 r.p.m. and 16,000 r.p.m. can be maintained. With the larger of the two cameras now installed at South Kensington, a vertical film speed of 160 metres per second can be secured readily. Owing to the massiveness of the driving-wheel and the balance of the moving parts, very smooth running is attained, the vibration even at the highest speeds being remarkably small. The rate of the drum is measured by a Hasler high-speed counter which can be put in action at any moment, and works automatically. Having had the privilege of testing this driving gear recently, I was delighted with its steadiness over a wide range of speeds, and speaking from a long experience, could assure Messrs. Bone and Fraser (to borrow the words of Mr. Staple) that I "envied them the luxury of their own feelings on this occasion".

With this fine instrument the authors have followed in detail the spread of the flame in carbonic oxide knall-gas, both when moist and when submitted to various stages of drying up to the desiccation produced by contact with purified phosphorus pentoxide during eight months.

SPREAD OF FLAME IN CARBONIC OXIDE KNALL-GAS.

The first photographs in the memoir bring out very clearly the difference in the burning of the moist and dried gases. Fig. 1 (with a moist $2CO + O_2$ mixture) shows how the flame starts rapidly with an accelerating motion for the first 5 cm. from the powerful discharge spark; it then slackens and proceeds at a nearly uniform rate to the ends of the tube. At this moment there is a sudden increase of luminosity, which spreads backwards towards the centre of the tube. The region immediately round the sparking wires is at first more luminous than the flame fronts, forming a bright vertical streak on the film. It is probable, as the authors say, that the combustion is more rapid near the spark than elsewhere, and this is borne out by the fact that this narrow zone loses

ts light and remains *dark* when the central region becomes luminous again—an indication that this layer of gas is completely burnt. Analysis of the residual gas showed that after the flame died out the combustion was complete throughout.

On the other hand, when the ignition occurs (Fig. 2) in a moderately dried gas (6 hours' contact with phosphorus pentoxide), the flames start slowly, but with an increasing speed, until, about 6 cm. along the tube, they are retarded and proceed at a slow uniform pace nearly, but not quite, to the ends of the tube. During this slow uniform movement, a dark patch spreads from the centre of the tube and occupies a central zone 10 cm. long by the time the outward movement of the flame ceases. At this moment, some 120 milli-seconds after the spark, the dark patch contracts, and a bright flame nearly fills the central region of the tube, leaving (as in the moist gas) only a narrow dark streak. The luminous flame persists in this semi-dried gas six times as long as in the moist, and about 1 per cent of the gas was left unburnt.

With stronger drying the flames last longer (Fig. 3), and where the first retardations occur, after 3 cm. run, actually stop for a considerable time, and then proceed outwards until a second

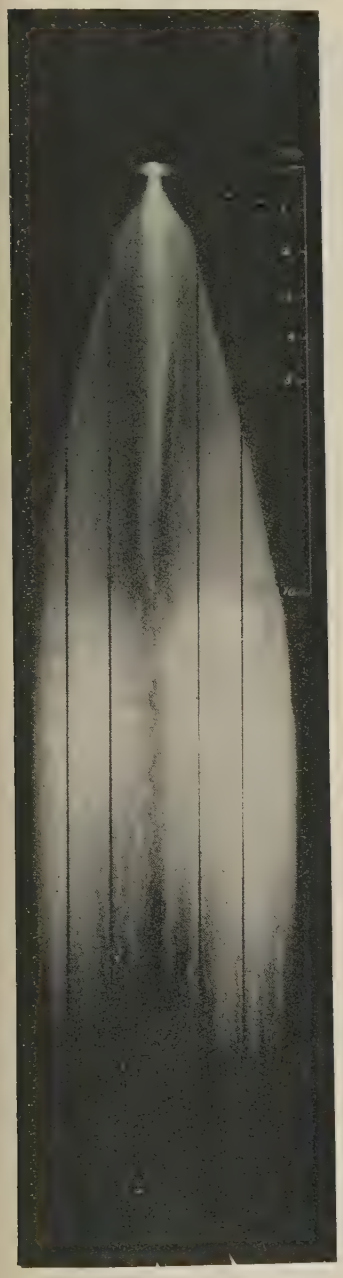


Fig. 1.[1]

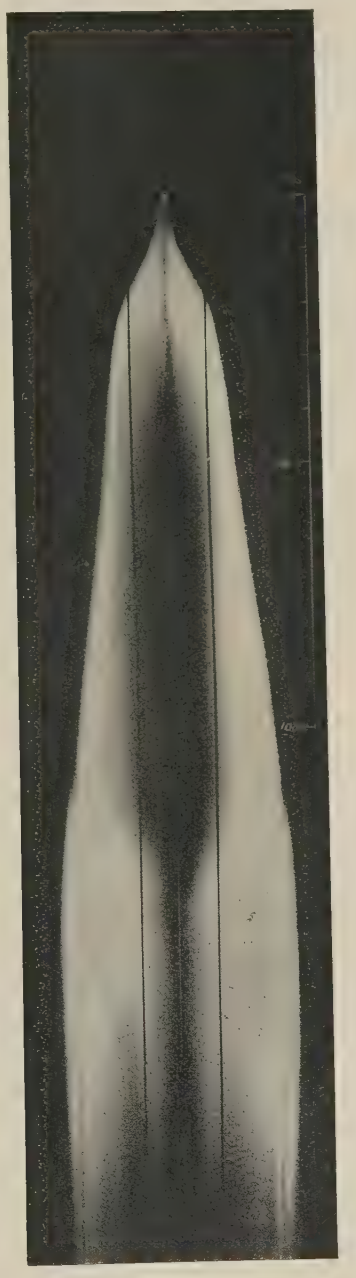


Fig. 2.

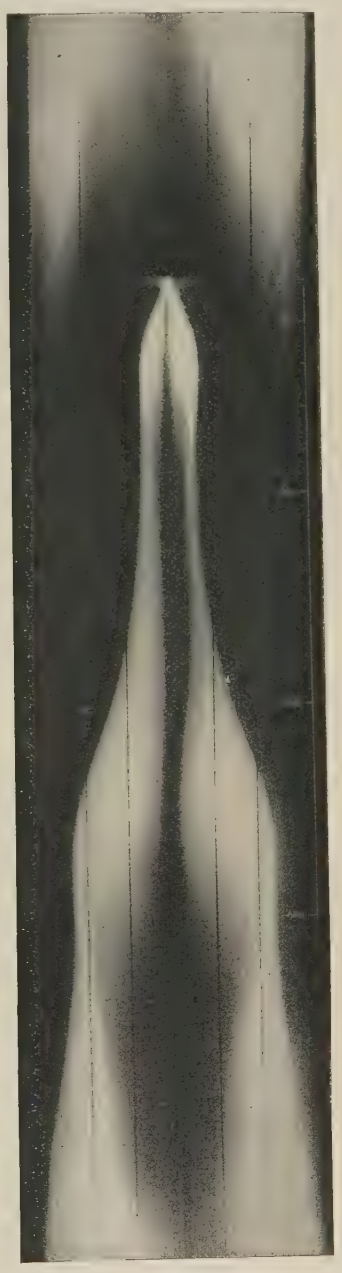


Fig. 3.

[1] The illustrations are from *Phil. Trans.*, A, **228**, by courtesy of the Royal Society and Prof. W. A. Bone.

stationary period ensues. Each stoppage is accompanied by the development of a dark central zone; the flames finally reach the ends of the tube when the usual re-luminence spreads backwards. In this slow flame, although it had spread completely through the tube, more than 10 per cent of the gas remained unburnt. It is to be noticed that while the rapid flame in the moist knall-gas is traversed by marked bands, similar to the 'reflection' waves in my old photographs, there are no such bands visible in the flames of the dried gases.

In similar experiments made in a longer tube (60 cm. long) the same general phenomena were recorded; but in the moist mixture the initial period was marked by vibrations, and in the well-dried mixtures the 'halts' became temporary 'retreats', and the flames appeared to be drawn back and extinguished before they reached the ends.

In these experiments on long-dried mixtures, a large proportion of the gas remained unburnt. It was such a desiccated knall-gas that I saw tested in Prof. Bone's laboratory. It resisted ignition by many powerful sparks; but when at last the electric discharge sufficed for inflammation, the flame could be easily followed by the eye until it halted, remained stationary, and went out about half-way along the tube. The colour of the flame appeared to me different from that in the moist gas—the front of the flame being a pinkish orange. This colour was perhaps more marked when long-dried knall-gas was exploded in glass bulbs.

I may add that, more recently, I have witnessed similar experiments elsewhere—the conditions of dryness and purity being equally assured. The knall-gas showed the same resistance to powerful sparks, but when ignition took place the flame travelled with a slow motion to the ends of the tube.

This part of the South Kensington research is concluded with a very suggestive experiment. Two similar tubes were filled with the knall-gas from the same holder: one tube was plain and the other furnished with wires sealed in half-way between the central firing-point and the two ends. After prolonged drying each tube was fired centrally, the second tube having the supplementary wires attached to the two poles respectively of a Wimshurst machine. The flames in both tubes are seen to start slowly. In the plain tube the flame halted twice, then *receded* and went out: in the second, the flames travelled at unequal rates, which, on the flames approaching the charged wires, were greatly accelerated. On the arrival of the flames near the ends of the tube, their brightness is suddenly increased, and this luminosity extends backwards until it nearly fills the tube except for the central dark zone. It was evident that the resistance to combination offered by the dryness of the gases could be overcome by the electrostatic field, and apparently this 'relief' was more easily given by one pole than the other.

I have seen other effects of the electric field on the propagation of the carbonic oxide flame obtained in Prof. Bone's laboratory since this memoir was read: I can only say, without anticipating the explanation, that the problem presented by the burning of this gas has become one of the most interesting in physical chemistry.

The Effect of Different Spark Discharges.

In part 2 of their memoir the authors study the effect on the flame of different modes of ignition of the moist knall-gas. There is little difference

FIG. 4.

between the spread of the flame when the ignition is made by heating a platinum wire to redness or by suddenly fusing a fine wire. In each case there *appeared* to be some little delay before ignition; the flame then started with its usual acceleration and slowed down to a nearly uniform speed after a run of 7 cm. When the same mixture was fired by

a high tension magneto-spark there was a measurable delay, but the spread of the flame followed much the same course.

The same kind of records was obtained when the moist gas was fired by the discharge from a condenser (charged up to 1000 volts) of increasing capacity, beginning with one of 0·001 mf. and passing on to 0·05, 0·5, and 3·75 mf., and then up to 8, 12, and 18 mf. With the lowest spark energy there appeared to be some delay in ignition; in the other cases the flame started immediately.

With the very powerful discharge sparks employed, oscillations were set up which had a visible effect on the flame from the start, and persisted so long as the flame was luminous—showing the well-known criss-cross patterns. There was also near the electrodes the very brilliant core of flame which burnt itself out rapidly and became a dark space. However fired, the spreading flame in the moist gases only became bright on reaching the ends of the tube.

Fig. 5.

While some photographs given in the memoir appear to show that, when the ignition is started close to one end of the tube, the flames exhibit a mean speed and a set of oscillations nearly identical, although a heavy discharge is used in one tube and a light spark in the other; yet the beautiful photograph (Fig. 4) shows that, when the knall-gas is lighted simultaneously at one end by a heavy discharge and at the other by a light spark, the flames start unsymmetrically—that from the heavy discharge travelling the faster. This last photograph strikingly illustrates the oscillations of the two flames and of the column of unburnt gas between them: when the flames at last meet, the striæ, which until that moment were moving *away* from the flame fronts, immediately became motionless and appear as vertical streaks.

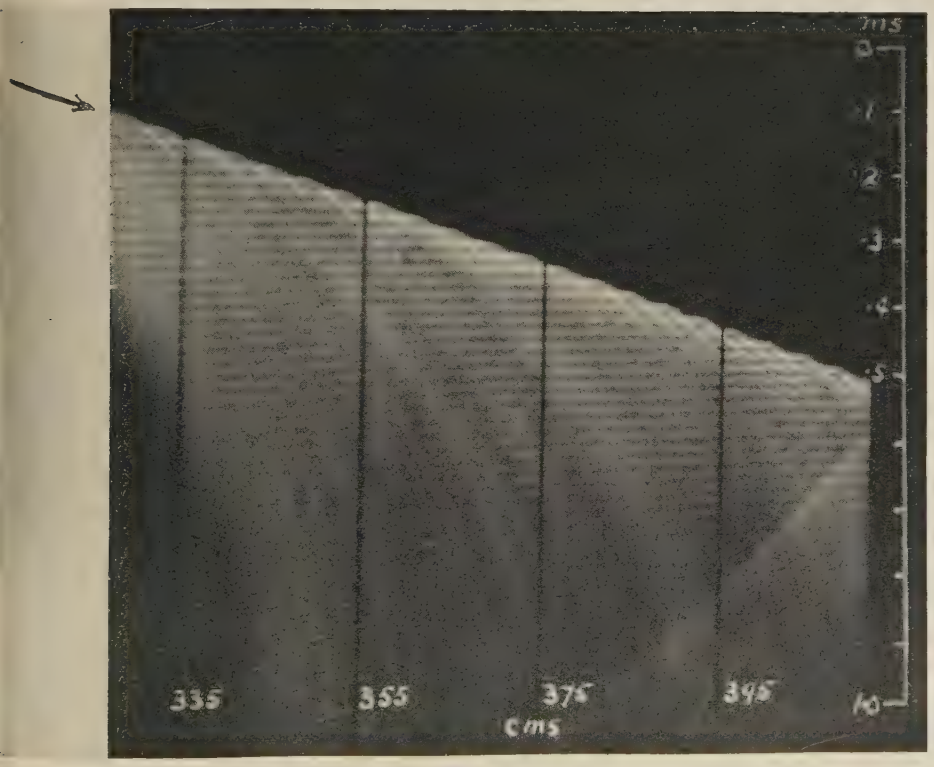


Fig. 6

Finally, by an ingenious device, the authors have studied the effect of shock-

waves catching up the accelerating flame, and of the accelerated flame overtaking shock-waves that have passed through it previously. They have shown how such shock-waves may impose a succession of 'uniform movements' on the flame, and how these accelerated flames may start a measurable distance ahead of the visible flame. When first confronted with such pre-ignitions, I attributed the appearance to halation on the photographic film; but the later work by Dr. Campbell at Manchester has long convinced me that the explosion wave may start under the influence of an invisible shock-wave ahead of the visible flame.

I agree, then, with the authors on their interpretation of the interesting photograph (Fig. 5). It is interesting not only because it shows the detonation starting at a point in front of the visible flame and throwing back a well-marked retonation wave, but also because it shows the peculiar banded structure (discovered by Dr. Campbell and his colleagues) not only in the explosion wave, but also in the region before the detonation is set up. Fig. 6 gives an excellent illustration of the banded flame of the explosion wave, which, the authors agree, must be attributed to the rotation of the head of the flame round the inner surface of the tube as it advances with a helical motion—the explanation suggested and then demonstrated by Messrs. Campbell, Woodhead, and Finch. How this rotation is checked when the flame comes in contact with an electrified surface is only hinted at in the present memoir, but already the Fraser camera has brought other mysteries to light. It is a fine weapon—and in capable hands.

Molecular Spectra and Molecular Structure.

THE Faraday Society met at Bristol on Sept. 24 and 25 for one of its valuable discussions on subjects of interest to physicists and chemists. The subject for this discussion was molecular spectra and molecular structure, and the importance of the subject could be gauged from the number of distinguished workers who were attracted from Germany, Holland, Switzerland, America, India, and Japan, and from the fact that thirty-eight papers were presented for discussion. These papers covered the whole field of inquiry in molecular spectra and focused attention on some of the problems still outstanding. The discussion was particularly valuable as it brought together workers in the infra-red, visible, and ultra-violet regions and provided them with an opportunity of correlating their results with those recently obtained from a study of the Raman effect.

One of the most important questions to be discussed was that of notation, for the present lack of agreement causes much unnecessary difficulty in the reading of the prolific literature which is at present being published. R. S. Mulliken, F. Hund, and others have recently agreed upon a tentative scheme, which was presented by O. W. Richardson. The main object of this scheme is to devise a notation in as close harmony as possible with that already agreed upon for atomic spectra. The quantum numbers n and l are retained with meanings analogous to those used for atoms, and in addition a quantum number λ is introduced for the projection of l on the molecular axis. Small letters are used for individual electrons, and capital letters for the electron system as a whole. Thus, the resultant of the l values of individual electrons is denoted by L, and the resultant orbital angular moment round the molecular axis by Λ. The individual electron spins are denoted by s, and the resultant by S, while the projection of S on the molecular axis is denoted by X. The quantum number of the sum total resultant angular momentum is denoted by J as in atoms. This consists of the electronic spin vector S and the resultant of orbital and rotation angular moments (together denoted by K). When individual electrons are known to have a definite angular momentum round the molecular axis, they are described as σ, π, δ, ϕ, . . . electrons according as $\lambda = 0, 1, 2, 3$ . . ., in analogy with the s, p, d, f, . . . notation of atoms. For the molecule as a whole, the molecular states are denoted by Σ, Π, Δ, Φ, . . . according as $\Lambda = 0, 1, 2, 3$, . . ., again in analogy with the S, P, D, F, . . . terms of atoms. Multiplicities are denoted as in atomic spectra, as, for example, ${}^2\Sigma$, ${}^4\Pi_{3/2}$.

There seemed to be general agreement among workers present at the discussion with regard to these main features, and criticism was directed mainly against other minor details. Those interested in polyatomic molecules urged, however, that the notation adopted for diatomic molecules should be capable of extension to more general cases.

One welcome feature of the discussion was that it led to a general stocktaking of the present position, and stimulated workers to review the advances made in the last few years. O. W. Richardson gave a summary of the results obtained for the hydrogen molecule, of which about forty different electronic levels are now known. W. E Curtis gave an account of the present position with regard to the band spectrum of helium, the analysis of which is nearly complete in the visible and ultra-violet regions. This spectrum is particularly interesting, as it shows that the l vectors of the individual atoms gradually become uncoupled from the nuclear axis as the rotation of the molecule increases and tend to become coupled to the rotation axis. The transition from one case to the other gives rise to striking anomalies of structure and intensity.

Apart from hydrogen and helium, the band spectrum which has received most attention is carbon monoxide, and at present 16 band systems are known. A detailed account of these was given by R. C. Johnson, who directed attention to the recent discovery by Asundi of a quintet level ${}^5\Pi$ in this spectrum (the first quintet to be recorded in band spectra) and attributed the third positive carbon band system to a ${}^5\Sigma \rightarrow {}^5\Pi$ transition. This

conclusion is important, because, if correct, it necessitates a modification of the electronic levels of the CO molecule hitherto accepted. Johnson proposed a detailed scheme for the electronic configurations of carbon monoxide in its various levels. He also indicated the states of the carbon and oxygen atoms after dissociation from each state.

Molecular Formation and Dissociation.

It is a matter of the greatest importance to the physicist and chemist to know what are the exact states of excitation of the component parts of a molecule on dissociation, for this knowledge can be used to control the reverse effect of combination. J. E. Lennard-Jones proposed an *Aufbau* principle for a number of diatomic molecules which provided this information. This investigation showed on theoretical grounds that some molecules would be expected to dissociate into normal components, others into one or more excited components. The molecular ion N_2^+, for example, would be expected to dissociate from its normal state into one *normal* N atom and one *excited* N ion, and it has been shown recently by Heitler and Herzberg that the experimental results point to the same conclusion. Other cases where a normal molecule separates into excited atoms were given in a paper by E. Bengtsson and E. Hulthén (Stockholm), who described some new results obtained for the spectra of some metal hydrides (CuH, AgH, AuH, etc.). A typical result is that CuH separates from its normal $^1\Sigma$ state into an excited Cu atom ($^2D'$ state) and an H atom in a 3*d* level.

F. Hund (Leipzig) contributed a paper on the general criteria for chemical binding. Theoretically, it is now possible by the new quantum mechanics to work out the interaction of two atoms in a molecule, but actually the calculations are so involved and so laborious that they have been carried out only in one or two simple cases, and it is desirable to have other simpler methods to indicate whether two atoms can combine to form a stable molecule or not. A method successfully used by Hund in many cases can be illustrated by considering the two pairs of atoms H + H and He + H in their fundamental states. One can form a molecule (H_2), the other probably not (HeH). The characteristic difference may be ascribed to the change in binding of the electrons in the two hypothetical processes: $H + H \rightarrow H_2 \rightarrow He$, and $He + H \rightarrow HeH \rightarrow Li$. In the first case, the binding of the electrons increases in the transition from the separated atoms to the united atom, while in the second case the binding of one of the three electrons is considerably diminished.

One of the interesting results of the work on band spectra is the determination of heats of dissociation. It has been observed that sets of vibrational levels often approach a point of confluence, that is, the separation of successive levels approaches zero, and it is now generally agreed that at the point of confluence one portion of the molecule (usually an atom) is separated from the remaining portion. If the vibrational energy levels can be followed up to, or almost up to, the point of confluence, the energy required for dissociation from the electronic level concerned becomes known. The ordinary heat of dissociation, as defined by the chemist, can then be deduced when the energy content (that is, the state of excitation) of the dissociated atoms is known. Unfortunately, it is not always possible to obtain a full set of vibration energy levels up to the limit of dissociation, and when only an incomplete set can be obtained, special methods have to be employed to infer the correct interpolation to dissociation. The most successful of these methods was given by Birge and Sponer three years ago and applied to nitrogen, oxygen, carbon monoxide, and other molecules. An improved method is now suggested by R. T. Birge which was described in a communication to the discussion. The essential point of the paper referred to a new method of plotting the frequency of vibration, which, it was claimed, leads to more trustworthy values of the heat of dissociation. The most probable values of the heats of dissociation of nitrogen and oxygen are now given as 9·1 volts and 6 volts respectively. Out of this investigation has emerged the fact that in many cases the plot of the frequency differences against quantum number possesses a point of inflection, which, it is suggested, is due to a discontinuity in the process of dissociation; it is considered that at the discontinuity, a molecular rearrangement occurs.

The band spectra of polyatomic molecules show a more gradual transition from band to continuous spectra. V. Henri and his colleagues find that with complex molecules the bands become *diffuse* before passing into a continuous spectrum. These diffuse bands are attributed to a loss of rotational quantisation. V. Henri employs the term 'predissociation' to indicate the state of the molecule after receiving energy corresponding to the wave-lengths in these diffuse bands, and brings forward evidence to show that in this state the molecule is photochemically active. He concludes that the vibrational bands become diffuse on account of a molecular rearrangement which takes place within a time interval which is less than the period of rotation but greater than the period of vibration of the molecule. This rearrangement may consist of dissociation into atoms or may be due to some change of molecular level. In a discussion of the above phenomena, V. Henri showed that the production of diffuse spectra is favoured by raising the temperature. A paper by S. Barratt reported the occurrence of similar diffuse bands in the spectra of the molecules formed by zinc, cadmium, and mercury with the alkali metals.

Ellis has applied the methods of Birge and Sponer to the calculation of the heats of dissociation of C – H and N – H groups in organic compounds. The results are in agreement with thermal data and indicate that the heats of dissociation of these groups are dependent on chemical constitution.

A paper by Goodeve and Stein on the absorption spectrum of chlorine dioxide provided an interesting example of a change of slope on the frequency difference–quantum number curve. This is of a different type from that discussed by Birge.

The rotational structure of the vibrational bands disappears at the point of change of slope; thus these experiments link up with those of V. Henri on predissociation. The theoretical basis of such phenomena is far from being understood.

Band Spectra and Atomic Nuclei.

The study of band spectra promises to be a valuable source of information about the masses and structure of nuclei, and in particular seems likely to lead to the discovery of many new isotopes. The rapid advances which have been made in this field during the past year were summarised by R. T. Birge. Already it has been established that there are oxygen isotopes of mass 17 and 18, and that carbon has an isotope of mass 13. It may be that *all* elements have isotopes, although the agreement of Aston's mass determinations with the usual chemical atomic weights proves that any isotopes as yet unknown can only be present in very small amounts. For the detection of such faint isotopes, the analysis of band spectra seems superior to the mass spectrograph, though, as band spectra give only *relative* masses of two isotopes, the two methods must be used to supplement each other.

The evidence of band spectra as to the *spins* of nuclei was summarised in a paper by R. S. Mulliken. In the spectra of molecules which contain two nuclei, equal both in charge and mass, every other line in each series of band lines is relatively weak or else missing. Heisenberg and Hund have suggested that this phenomenon can be explained by assuming that a necessary condition of existence for any state of a molecule is that it be antisymmetrical in all protons as well as in all electrons. The correctness of this antisymmetry rule for the extra-nuclear electrons in atoms is well established by the facts of line spectra. Its applicability to protons is confirmed by the specific heat and band spectrum data for hydrogen,[1] but whether it applies to protons and electrons in complicated nuclei is still doubtful. There are difficulties in the case of N_2. In most cases the alternating intensities observed in the Raman effect are in complete agreement with those of band spectra and in accord with theoretical expectations; but for nitrogen, Rasetti finds that transitions between the even levels of the ground state are more intense than those between the odd levels. As nitrogen in the ground state is $^1\Sigma$ like H_2, and from the constitution of the nuclei would be expected to have a nuclear spin like that of hydrogen, the result seems to be in conflict with the rule given above.

It seems as if the eigenfunction of the nitrogen molecule is symmetrical in the nuclei. This means that the nitrogen nuclei follow the Bose statistics, whereas, as pointed out by Mulliken, they would be expected to follow the Fermi statistics, because they contain an odd number of particles which follow the Fermi statistics. In the course of the discussion, G. Herzberg gave the recently published views of Heitler and himself that in the nucleus the electron not only loses its spin (as shown by Kronig) but also its influence on the statistics. If true, this is a new and remarkable result.

[1] *Added in proof:* In a contribution to the discussion just received, J. C. M. McLennan finds similar confirmatory evidence from the Raman lines of liquid hydrogen.

The Raman Effect.

The discussion on the Raman effect was opened by Sir C. V. Raman, and papers were contributed by R. W. Wood, J. Cabannes, P. Daure, H. S. Allen, A. M. Taylor, and A. C. Menzies. Raman gave a historical survey of his discovery and emphasised the necessity for linking up the effect with the diamagnetic susceptibility and optical anisotropy of crystalline substances. The new method has opened out many possibilities of development for the chemist, in particular in the direction of increasing our knowledge of the vibration frequencies and structure of organic molecules. The light scattered when a beam of monochromatic radiation passes through gaseous, liquid, or solid media is resolved into a series of bands of frequency, $N \pm n$, where n corresponds with the characteristic rotation and vibration frequencies of the medium. The agreement between the values of n and the frequencies of the infra-red bands affords a proof of the correctness of Raman's interpretation of the spectra discovered by him. It is, however, one of the important features of the Raman effect, that the frequencies of the scattered radiation indicate the existence of vibrations in molecules which are optically inactive in absorption. These had already been inferred, but could not be demonstrated from the infra-red spectra. For example, Schaefer showed in his paper that the infra-red vibration levels of the CO_3 ion can only be interpreted on the assumption that a number of the absorption bands are due to inactive vibrations occurring in combination with active vibrations. The frequency of the optically inactive fundamentals which is required for adequate explanation of infra-red spectra, is precisely that which is found in great strength in the Raman effect. A parallel case is that of the molecule of carbon dioxide, the optically inactive vibration of this molecule coming out strongly in the Raman spectrum (Rasetti).

The high degree of dispersion which is possible by the Raman method, has resulted in the separation of the C – H bands into several components. Raman showed spectra in which this band is resolved into four clearly distinguishable components, a resolution which has also been effected by Petrakaln and R. W. Wood. The latter contributed a paper in which the improvements in experimental technique necessary to obtain this result were described.

It was emphasised that the frequencies of the lines due to C – H in aromatic and aliphatic compounds are different, and the degree of polarisation strikingly so. The lines from cyclohexane are intermediate between those of aromatic and aliphatic compounds. The theory of the intensities and degree of polarisation of the Raman lines received attention in papers by Cabannes, who

emphasised the value of the spectra in amplifying the information about crystal structure which is gained by the X-ray method. Daure directed attention to the differences between the spectra of liquids and gases, and pointed out the importance of the effect in the study of the association of liquids. A. M. Taylor's work on the Raman lines of AX_4 ions shows that the frequency of vibration is diminished on destruction of the crystal lattice and on hydration of the group, and Menzies described experiments in which measurements had been made of the Raman effect with powdered crystals (see also NATURE, Oct. 5, p. 511).

Structure of Unexcited Molecules.

In the last few years there has been a rapid advance in our knowledge of the rotational and vibrational levels of molecules in the unexcited state. The study of infra-red absorption spectra has revealed not only the magnitude of internuclear distances and the nature of structural arrangements in space, but also has yielded precise information about the rotational and precessional movements of molecules. Detailed knowledge is at present limited to simple molecules in the gaseous state. For complex organic molecules, studied in the solid or liquid state, only the vibrational levels have been systematically examined, such as those of C – H, C = O, C – OH, N – H, C ≡ N groups, and the manner in which the frequency of these levels changes with modification in chemical constitution. In an introductory address on the infra-red spectra of gases, Sir Robert Robertson outlined the advances so far made, especially with reference to their bearing on chemical problems.

E. F. Barker and C. F. Meyer, in a survey of the experimental investigations on the vibration bands of simple molecules in the gaseous state, proposed a method of classification of molecules into groups according to the complexity of the rotational levels. Diatomic and linear molecules like carbon dioxide and acetylene only rotate in a plane and show no precession. Methane, on account of its symmetry, can rotate about any axis without precession, but, in general, polyatomic molecules rotate with a precession the complexity of which depends on the molecular symmetry. Ammonia, ethane, methyl fluoride, etc., which have symmetry about one axis of rotation, give a less complex rotational structure than water, sulphuretted hydrogen, and ethylene, which possess three unequal moments of inertia. It is a curious fact that carbon dioxide is linear, while water is a triangular molecule.

A noteworthy advance is made in the interpretation of molecular spectra by the application of the conception of nuclear spin. The acetylene bands exhibit a striking example of alternating intensities which are analogous to those observed in molecular hydrogen and can be explained in a similar way. The two hydrogen protons of acetylene, both spinning in directions parallel to the axis of rotation, may have either the same, or opposite, spins. Thus there seem to be two types of acetylene molecule, just as there are two types of the hydrogen molecule. The bands of molecules like methyl fluoride and ammonia, which have triple proton symmetry about a rotation axis, show every third rotation level intensified. The double Q branch of ammonia at 10·3 μ and 10·7 μ was discussed by Robertson and Barker. The view expressed by Barker is that the atoms of the ammonia molecule are nearly, but not quite, in a plane. The potential energy function for such a molecule would be symmetrical about the plane of the hydrogen nuclei and would have a minimum on each side. The possible vibration levels of the nitrogen in such a field would divide into sets, the eigenfunctions for one set being symmetrical and for the other antisymmetrical. Moreover, the energy levels of each set would be approximately coincident. The symmetrical set would be present for one type of nuclear spin, the other set for another type of nuclear spin. Combinations between consecutive levels of the symmetrical set give one of the Q branches of ammonia and the combination between the corresponding antisymmetrical levels the other Q branch. The double Q branch in ammonia may, therefore, be ascribed to the nuclear spins, as the symmetry properties of these determine the permissible symmetry properties of the vibrational eigenfunctions.

Mecke and Badger have succeeded in photographing the higher harmonics of the frequency bands of ammonia which occur in the near infra-red. The fine structure of these bands is analogous to that of bands in the further infra-red. This is a marked advance in the technique of the study of vibration bands.

The vibration levels of the C – H, N – H, C = O, etc., groups are now known, due to the labours of Bonino, Lecomte, Ellis, Sallant, and others, and by the Raman method it is found that the C – H levels are multiple. There appears to be a level for each C – H group in the molecule, the greatest difference in frequency occurring between the levels of C – H in aliphatic and aromatic compounds. G. B. Bonino discussed the effect of chemical constitution on the fundamental frequency of this group, and considered the effect of lengthening the carbon chain, of the presence of the double linking between carbon atoms, and the influence of hydroxyl and halogen substitution. The extinction coefficients of the absorption bands are found by Bonino not to be proportional to the number of groups in the molecule; investigation of the individual C – H levels from this point of view has yet to be undertaken.

The Solid State.

In an address on the infra-red spectra of solid bodies, C. Schaefer summarised the information so far obtained with regard to the frequency of vibration of crystal lattices and the vibration of atoms composing physically distinct groups in the crystal. The detailed investigations of Schaefer on the crystalline carbonates and nitrates have brought to light the optically inactive vibrations of the CO_3 and NO_3 ions, and also have indicated in what manner the vibrations of the atoms in these groups

depend on the crystal symmetry. The main features of the vibrations of these groups, their frequency, for example, are but little affected by the cation. This is in accord with the structure of these ions as deduced by X-ray analysis. In uniaxial crystals, however, the frequency bands are doubled, and this may mean that the equilateral of the CO_3 ion is distorted, though this has not hitherto been detected by Röntgen analysis. The infra-red spectroscope can, therefore, be used to supplement researches with X-rays.

Water of crystallisation gives nearly the same frequencies of vibration as liquid water, but the bands are doubled in uniaxial and tripled in biaxial crystals, showing that the symmetry of the water molecule partakes of that of the crystal as a whole.

This collection of papers when published in book form will doubtless be a welcome addition to the libraries of those interested in molecular structure.

W. E. GARNER.
J. E. LENNARD-JONES.

Obituary.

WALTER HEAPE, F.R.S.

WALTER HEAPE, whose death occurred on Sept. 10, was the son of Benjamin Heape of Manchester, and Mary Heape, daughter of Joshua Heap of Liverpool. Walter was born in London in 1855, and after completing his education at the age of eighteen, entered into business, and was thus occupied until 1879. He was a man of some fortune, and had business interests in different parts of the world, and to these he devoted himself intermittently throughout a great part of his life. But at quite an early age he realised that he had a natural aptitude for scientific pursuits, and coming under the influence of Francis Maitland Balfour, he proceeded to study embryology, a branch of zoology which at that time was undergoing rapid development.

Heape came to live in Cambridge in 1879 as soon as he gave up business. In 1882 Balfour died, and the organisation of zoological teaching and research in Cambridge fell to Adam Sedgwick, who carried on the tradition of his department as a centre for embryological investigation. In conjunction with Sedgwick, Heape undertook the part-authorship of the well-known "Elements of Embryology", published under the names of Foster and Balfour, and for many years in constant use by students of zoology. In 1882 he was appointed demonstrator in animal morphology, but he had no great interest in teaching, and after two years relinquished the post to take up the duties of superintendent of the laboratory of the Marine Biological Association. This appointment he held for two years.

In 1890, Heape was elected to the studentship founded in memory of Balfour for the promotion of zoological research. He was the second Balfour student (succeeding Caldwell) and he occupied the position for three years, after which he held no further academic appointment.

Heape's earliest original work was that on the development of the mole, issued in the *Quarterly Journal of Microscopical Science* in 1886. This work is generally admitted to be a model of its kind and it definitely broke new ground. It was not, however, until Heape's tenure of the Balfour studentship that he commenced those researches on the comparative morphology and physiology of the reproductive processes for which he made his name famous. The earliest of these were upon the menstrual cycle in monkeys, and were published in two elaborate papers in the *Philosophical Transactions* (1894–97). Not only did Heape describe fully for the first time the histology of the uterine cycle, but he also gave an account of the ovarian changes, showing that although the uterine cycle may continue throughout the whole year, ovulation and breeding are often restricted to certain special seasons, and that menstruation, therefore, may occur quite independently of ovulation, a fact which has recently been confirmed by Prof. Corner. In order to investigate the subject as fully as possible, Heape went to India, where he collected his material, which consisted of monkeys of two genera. Afterwards he supplemented his researches by a study of the menstrual processes in woman, and published a paper in the *Transactions of the Obstetrical Society*. He also, about the same time, published papers on the successful transplantation of fertilised ova from one rabbit to another (and so into a uterine foster mother), on artificial insemination, and on fertility, barrenness, and abortion in sheep.

Heape's best-known work is probably his memoir on the "Sexual Season of Mammals", which appeared in the *Quarterly Journal of Microscopical Science* in 1900. It contains a comparative account of the œstrous cycle for all the different groups for which any data existed. This memoir formed the basis of much future work, and although a certain number of Heape's conclusions have had to be revised in the light of later investigation, the paper will always stand as the first important contribution to the comparative physiology of breeding in the higher animals. It is doubtful whether Heape ever fully grasped the significance of the endocrine functions of the ovaries, and he appears at one time to have entertained the view that the œstrous cycle might continue after these organs had been removed. But it must be remembered that he never had any training in physiology, neither had he worked in a physiological laboratory; yet, in spite of that, his work gave a remarkable stimulus to research in the physiology of reproduction. In 1905, Heape published a paper on ovulation and the degeneration of ova in the rabbit, in which he postulated the seasonal appearance in the blood of a 'generative ferment' which was responsible for the reproductive and sexual activities. It is interesting to note that he was the first to discover that in the rabbit ovulation is dependent on coition, and that it takes place almost precisely 9½ to 10 hours after coition, an observation which, with some modifications, has since been extended to other animals.

Heape was also interested in the question of sex etermination, and his latest papers were upon this ubject. It was at one time rumoured that in cer-ain instances he claimed to have controlled sex. Iis views, however, were shadowy, and he never early formulated them, but latterly, under the nfluence of the Mendelian discoveries, he adopted he theory that the gametes were themselves sexual, nd that in certain circumstances the environ-ent exercised a selective action on the life of the ametes, there sometimes being a preponderance of ale gametes surviving, and sometimes an excess f female ones. In support of this view he pub-shed papers on the sex-ratio in dogs, in canaries, nd in the human population of Cuba.

Mention must also be made of Heape's strong ppreciation of the practical side of his subject. Iis papers on fertility have been referred to above, ut he also wrote a book on "The Breeding In-ustry" (1906), in which he emphasised the econo-ic importance of that industry in Great Britain, he desirability of animal breeders keeping records f their experiences so that these should be avail-ble for future use, and the necessity for improved rganisation and for the application of scientific ethod to all branches of livestock breeding. Ieape showed also a practical interest in questions f fertility in man and published a book entitled Preparation for Marriage" (1914). Another ook he wrote was called "Sex Antagonism" 1913), and consisted largely of a criticism of ir James Frazer's "Totemism and Exogamy". Ieape also planned the publication of a text-book f comparative embryology to be completed in hree volumes. Of these, the first two only have ppeared, and he relinquished the editorship after he publication of the first volume, on the inverte-rates, by Prof. E. W. MacBride.

In 1891, Heape married Ethel, daughter of Joseph Ruston of Lincoln; she died in 1925. They had ne son and one daughter. When in residence at Cambridge, Heape joined Trinity College, and the Jniversity conferred upon him the honorary de-ree of M.A. in recognition of his work and position. Ie was elected a fellow of the Royal Society in 1906. fter leaving Cambridge in 1907, Heape lived suc-essively in Southwold and London and finally in Tunbridge Wells. He was a partner in the 'Heape nd Grylls' rapid cinema machine company.

Heape had a strong enthusiasm for his subject nd was ever ready to help and encourage others. Iad he been a teacher, there is little doubt that he ould have had many pupils who would have de-oted themselves to generative physiology. As it as, his influence lay chiefly in his writings.

F. H. A. Marshall.

Lady Bragg.

It is not easy to express in these columns the eep loss which science has sustained by the death f Lady Bragg on Sept. 29. She possessed the uality of radiating the sunshine of life wherever he was—at the University of Leeds, University ollege, London, and since 1920 at the Royal nstitution—and her gracious influence cleared away all clouds as surely as the sun does in the solar system, enabling us thereby to see the stars. It was impossible not to be uplifted and stimulated by her smile, and scientific workers both young and old will cherish it as a glad memory throughout their lives. She did indeed reveal to all with whom she came in contact the "purity of grace. The mind, the music breathing from her face, the heart whose softness harmonised the whole."

Both birth and circumstance combined to produce the note of perfect harmony in Lady Bragg's life. She was the daughter of Sir Charles Todd, Government Astronomer and Superintendent of Telegraphs, South Australia, and in 1889 married Sir William Bragg, who was then professor of physics in the University of Adelaide. By understanding, as well as by social position, she was therefore richly endowed with the power to give light and leading to all around her, and she used her gifts always to promote noble life and high endeavour. We offer Sir William Bragg our deepest sympathy at the loss of his devoted partner, whose influence will be greatly missed over a wide circle. We are thankful for her life, and find consolation in the thought that her spirit remains with us for help and guidance, though she herself has passed into silence.

We regret to announce the following deaths:

Prof. H. Beckurts, formerly professor of pharmaceutical and food-stuffs chemistry at the Technical Highschool at Brunswick and joint editor of the *Archiv der Pharmazie*, who issued the "Jahresbericht für Pharmazie" from 1881 until 1924, on Sept. 15, aged seventy-four years.

Frank Hurlbut Chittenden, entomologist in the bureau of entomology of the U.S. Department of Agriculture, known for his work on Coleoptera, on Sept. 15, aged seventy years.

Dr. Edward B. Craft, executive vice-president of the Bell Telephone Laboratories, vice-chairman of the engineering and industrial research division of the U.S. National Research Council, on Aug. 21, aged forty-seven years,

Prof. Andrew A. Kerr, head of the department of anthropology in the University of Utah, on Aug. 15, aged forty-nine years.

Dr. George P. Merrill, head curator of geology in the U.S. National Museum and a member of the National Academy of Sciences, known for work on petrography and the history of American geology, on Aug. 16, aged seventy-five years.

Mr. W. DeW. Miller, associate curator of ornithology of the American Museum of Natural History, on Aug. 4, aged fifty years.

Dean F. Franklin Moon, head of the New York State College of Forestry since 1920, and chairman in 1924–26 of the New York section of the Society of Foresters, on Sept. 3, aged forty-nine years.

Prof. R. P. Pictet, of Geneva, whose name will be remembered in connexion with his papers published in 1877–78 on the liquefaction of oxygen, aged eighty-four years.

Dr. Morton Prince, emeritus professor of neurology at Tufts College and associate professor of abnormal and dynamic psychology at Harvard University, who edited the *Journal of Abnormal and Social Psychology* and was president in 1909 of the American Neurological Association, on Aug. 31, aged seventy-four years.

News and Views.

THE views expressed in our leading article in this issue upon the composition of the Royal Commission on the Civil Service represent, we believe, the feelings of scientific workers generally. As at present constituted, the Commission cannot be regarded as competent to assess the importance of according to the scientific and professional staffs of the Civil Service their share in formulating policy. The Royal Commission will also have to consider whether an administrative structure designed to meet Victorian conditions has adapted itself to modern needs, and in this connexion the Commission would undoubtedly have been strengthened by the presence of one of those students of public administration whose names are familiar to those who have before them the ideal of efficient State machinery. In our issue of Aug. 31, we referred to the proposals submitted by the Institution of Professional Civil Servants to the Treasury Committee presided over by Sir Harold Carpenter for the creation of a unified State Scientific Service, of which a Ministry of Science would be the ultimate expression. We learn that the chairman has ruled that the latter project is outside the terms of reference of the Committee, although they include the examination of the functions and organisation of the scientific and research establishments. In view of the chairman's ruling, it is evident that the Institution's proposals for the unification of the scientific services will have to be carried to the Royal Commission.

IT is absolutely essential to an adequate consideration of far-reaching structural proposals of this type that scientific workers of standing should be added to the Royal Commission. Royal Commissions on the Civil Service come at necessarily lengthy if fairly regular intervals, and it will be disastrous if, through the absence of any representatives of those elements which have determined the course of modern social evolution, the traditional organisation of the Civil Service should be stereotyped for another twenty years. The Council of the Institution of Professional Civil Servants has signified "its concern that the Commission includes no representative of science, no representative of the professions (other than accounting), and no person of eminence who has devoted study to the problems of public administration", and feels strongly that "the presence of such representatives would have been of great assistance to the Commission in its deliberations, and would have increased the confidence of the public and of the Civil Service in its ultimate findings". Few scientific workers will dissent from this view; it is to be hoped that steps will be taken to repair these omissions.

THE absence of any attempt on the part of our Governments to create a national reserve in Britain has more than once been referred to in the columns of NATURE. The United States of America and our own dominions and colonies have led the way in setting apart great tracts of country for the preservation of wild Nature as it is represented by striking features of topography and by forest, flora, and fauna; all for the education and pleasure of the people now and in years to come. It may be urged in excuse of our lack of action that these younger countries are favoured with great open spaces and a sparseness of population which make it an easy matter to stay the march of civilisation in some remote district. Yet, remoteness is a relative term, with wide interpretations, as is shown by the controversy over the Zululand reserves to which we referred in a leading article on Nov. 24, 1928. If we turn to the older and more populous countries of the world, our excuse would appear to become thin indeed, for there is scarcely a State in Europe or abroad but has been able to afford, and has thought it worth while affording, space for one or more national parks of considerable area. Further, comparison of the condition of Great Britain, from the point of view of cultivation and settlement, with the conditions in European States does not support the idea that density of population or extensiveness of agricultural activities are less favourable to the creation of a national park here than on the Continent. Speaking roughly, about 18 per cent of the total land surface of Great Britain is unproductive, against some 20 per cent in each of Russia and Spain, 14 per cent in France, 13 per cent in Italy, and 9 per cent in Germany. Here, surely, even in Britain, is room for a national reserve.

ON these grounds, it is with interest and hope that we observe the announcement, published on Oct. 2, that the Prime Minister has appointed a Committee to canvass the possibilities of a national park in Great Britain. The terms of reference are wide: "To consider and report if it is desirable and feasible to establish one or more National Parks in Great Britain with a view to the preservation of natural characteristics including flora and fauna, and to the improvement of recreational facilities for the people; and to advise generally and, in particular, as to the areas, if any, that are most suitable for the purpose." The Committee selected is a strong one, composed of representatives of Government departments likely to be concerned in the project—Agriculture and Fisheries, Crown Lands, Health, Scottish Agriculture, Home Office, Office of Works, Forestry, and, last but certainly not least, the Treasury. We have only one criticism to make concerning the composition of the Committee, and we consider it to be a serious one. The preservation of the fauna and flora must be one of the prime ends of the creation of a national park; indeed, in other lands the existence of the wild inhabitants of the reserves is the subject of the most careful consideration and of detailed regulations bearing upon the public and the relations of the creatures themselves. That being so, it seems extraordinary that the Committee should include no scientific naturalist, familiar with the minute distribution of beasts and birds in the wilds of Britain, with the compatibilities of existing species, and with the possibilities of introducing species now extinct in particular areas.

THE reports on the annual meeting of the British Cotton Industry Research Association, held in Manchester on Oct. 1, are notable in that they mark a new phase in the activities of one of the largest of the

ndustrial research associations in Great Britain. The Association is now starting on the third of the five-rear periods into which its existence has been divided or financial reasons. The Department of Scientific nd Industrial Research has made large grants to the Association during the past ten years for development urposes, and it was thought that the cotton industry vould take on the responsibility of maintenance of the Association at the end of this period. The cotton ndustry has doubled its contributions to the Associa-ion during the second half of this ten-year period, but, vith the exception of the finishing section, the industry inds itself unable to increase its subscriptions to meet he demand for £75,000 per annum which the Council f the Association considers necessary for the develop-nent of its work during the next five years. In this pinion the Council is supported by the Department f Scientific and Industrial Research, which has ffered, and the offer has been accepted, to contribute pound for a pound on all income from approved rade sources exceeding £25,000 per annum. At the ame time, the Department holds the view that the ost of maintaining the present operations of the Association should be borne by the industry. The Association is now assured of an annual income of £60,000, which is £15,000 less than the amount the governing body considers necessary for the successful development of its plans.

The work of the Association during the past ten ears has been directed mainly to the examination of he properties of cotton in all its forms. Thus many ears have been spent by a large and capable staff of cientific workers in laying the foundations on which arger scale investigations could build. The Associa-ion is extending its premises to house machines epresenting those used in modern practice with which arger scale investigations will be made. The relation-hip between the Association and the cotton industry s now reaching an interesting and critical stage, and he next five years of the Association's work will be nxiously followed by all who believe that the salva-ion of the industry lies in extensive research work. t is very unfortunate that the industry and the Associa-ion are simultaneously passing through a depressing ime. If the next five years do not bring the desired rade revival, it is difficult to foresee how the industry vill be able to make use of the work of the Association. £75,000 per annum is a very large sum, but it is only a mall fraction of the amount which would have to be xpended in putting semi-practical scale results into uccessful practice. The simultaneous arrival of a rade boom, a successful period of research work by he Association, and a body of men sufficiently capable f making and successfully carrying through large cale changes in industrial method, appears to be the nly hope for a happy issue from a difficult situation.

The international exchange offices (for the collec-ion and dispatch of consignments of literature) which ave been set up as government departments on the Continent have no exact counterpart in Great Britain. Their functions have been to some extent undertaken y the Universities' Library for Central Europe, stablished in 1921, in co-operation with the Universities' Relief Committee, to co-ordinate and consolidate the securing by gifts, exchange and purchase, of British books, journals, etc., to meet requirements, otherwise likely to remain unprovided for, in continental universities. In our correspondence columns this week (p. 576) appears a letter from the honorary secretary appealing for support for what must be regarded, by all who believe in the world value of British thought and achievements in science and the humanities, as a work of vital importance. It will be noticed that the British Museum, the Royal Society of Edinburgh, and the University of Leeds make use of the Library's outward services. Offices are supplied rent-free in the London School of Economics, and a large proportion of the work is carried out with voluntary assistance. Opinions may differ as to the expediency of national governments undertaking work of this kind and the consequent risks of intrusion of political considerations and designs, but exception can scarcely be taken on principle to the suggestion of a modest but regular government grant for enabling the Universities' Library to give to its work the comprehensive character without which it labours under a heavy disadvantage. It is merely a question of evaluation of the work — and this from at least two points of view. It is clearly a national interest, deserving support from the national exchequer, that international commerce of ideas should flourish, and likewise that international amity should receive such stimulation as can be afforded by a knowledge abroad of English culture and ideals, language, literature, and methods of government. The service in question seems well designed for the promotion of both interests.

At the end of September last, Prof. J. W. Gregory left the University of Glasgow on his retirement from the chair of geology, thus bringing to a close twenty-five years of honoured and fruitful service to the University. During that period the membership of his classes has risen from 15 to 400, and in his last session he lectured to the largest geological class in the British Isles, if not in the world. His skill as an organiser and his powers as a lecturer have been well displayed in dealing with the unique teaching problems brought about by these enormous numbers. Under his inspiration and guidance, the Glasgow geological school has produced a large amount of original work, which, in recent years, has been embodied in the annual volume of Collected Papers from the Geological Department of Glasgow University. Prof. Gregory has inspired numerous young men to take up geology as a career, many of whom are now in prominent positions in the geological world. He retires with the good wishes and affectionate regard of a host of present and former students, staff, and other friends.

It is almost impossible in a paragraph to recount Prof. Gregory's scientific work, or to assess his influence on geology. His extraordinary versatility and powers of work are well known. Not only as geologist, but also as geographer, explorer, and social economist, has he won scientific fame. His twenty books and three hundred papers cover subjects ranging from palæontology to ore deposits, from the geology of

East African rift valleys to the origin of fiords, from structural and comparative geography to social problems such as the 'menace of colour' and human migration. His journeys in East Africa, Spitsbergen, Central Australia, Cyrenaica, Benguella, and Chinese Tibet are well known, and his racy travel books are models of their kind. There is scarcely a department of geology which he has not enriched by original observation and illumined by brilliant theory; and while he has been accused of a tendency to champion 'lost causes', his views have been frequently vindicated in the advance of the science, the latest example being found in Prof. A. Holmes's letter to NATURE (Sept. 28, 1929, pp. 477-8) on "Ore-lead and Rock-lead and the Origin of certain Ore Deposits".

Two notable personalities on the roll of English science celebrated birthdays during the past few days: they are Sir Philip Magnus, Bart., who, on Oct. 7 celebrated the eighty-seventh anniversary of his birth, and Prof. W. C. McIntosh, whose anniversary, on Oct. 10, marked the span of ninety-one years. Sir Philip Magnus was educated at University College School. One of the oldest living graduates of the University of London, he was its Parliamentary representative from 1906 until 1922, whilst for upwards of thirty years he acted as superintendent and secretary of the Department of Technology, City and Guilds of London Institute. Prof. McIntosh, born at St. Andrews, where he still manifests amazing vitality, is an *alumnus* of the ancient university of that city. His reputation as a zoologist is world-wide. He has added to our knowledge of sea fisheries in remarkable measure, and their industrial importance has been much enhanced through his labours. He was the first to found a marine biological station in Great Britain. Prof. McIntosh is a Royal medallist of the Royal Society.

So much is at present under discussion respecting naval disarmament, sea power, and treaties of parity, over and above which looms a Five-Power Conference for next year, that it seems opportune to recall that the foundation, in 1900, of the Sir George Chesney gold memorial medal by the Royal United Service Institution was followed by its unanimous award, in the first instance, to that distinguished officer of the U.S. Navy, Capt. A. T. Mahan. When the initial award of the medal was considered, it was resolved that Capt. Mahan should be invited to accept the distinction in recognition of the three great works of which he was the author, namely, "The Influence of Sea Power upon History", "The Influence of Sea Power upon the French Revolution and Empire", and "The Life of Nelson". In acknowledging the gift Capt. Mahan recorded his satisfaction that "my works have contributed in some degree to the welfare of the British Empire, the strength of which is so essential to the cause of our English-speaking race, and of mankind in general".

ON Oct. 15 occurs the centenary of the eminent American astronomer Asaph Hall, the discoverer of Phobos and Deimos, the two satellites of Mars. Born at Goschen, Connecticut, he was left an orphan at thirteen years of age, and from the village school became an apprentice to a carpenter. He made unusual use of his opportunities, however, and was able to study mathematics at Norfolk, Connecticut, Mcgrawville, New York, and at the University of Michigan, and in 1857 became an assistant to Bond at Harvard Observatory with a salary of three dollars a week. In 1862 he joined the staff of the Naval Observatory at Washington, and the following year was appointed a professor of mathematics in the United States Navy. He remained connected with Washington Observatory until 1891, counting among his colleagues Gilliss, Newcomb, Harkness, Hubbard, and Eastman. He was placed in charge of the 26-in. refractor in 1875, and with this instrument on Aug. 11, 1877, he discovered Deimos and on Aug. 17, Phobos. The names, we believe, were due to Madan (1838–1901), the first science master of Eton. It has often been pointed out that Kepler had predicted the existence of two satellites to Mars, and that such bodies figure in the romances of Voltaire and Swift. Hall was among the first to appreciate the value of observations of Mars for determining the parallax of the sun; he took part in solar eclipse expeditions, was an industrious observer of double stars and contributed papers on the secular perturbations of the planets. He received the Royal Astronomical Society's Gold Medal and many other honours. Five years after retiring from the Navy, in 1896, he was appointed to a chair of astronomy at Harvard, which he held until 1901. Hall died on Nov. 22, 1907.

IN a letter in the *Times* of Sept. 30, the Earl of Scarbrough describes and illustrates the monument which has been erected on Jebba Island in the Middle Niger to the memory of the African pioneers, Mungo Park and Richard Lander. The movement for the erection of the memorial originated in 1911 with Lord Curzon, president of the Royal Geographical Society; Sir G. T. Goldie, president of the African Society; and Lord Scarbrough as chairman of the Niger Company. Park, who was born near Selkirk in 1771, made his first journey in 1795–97 from the Gambia to Silla and near the sources of the Niger, and his second in 1805, which terminated in his death in the Bussa rapids not far above the site of the present memorial. Lander was born in Truro in 1804 and made his first journey in Africa in 1825, and was with Commander Clapperton (1788–1827) when the latter died near Sokota. Afterwards he made two expeditions to explore the River Niger, and it was during these that the question of the course and outlet of the river was settled. Attacked in canoes by the people of one of the Brass River chiefs, he was mortally wounded at Ingiamma, and died at Fernando Po on Feb. 6, 1834. The memorial consists of an obelisk 40 feet high and 11 ft. square at the base, built of concrete faced with granite. The tablet bears the inscription, "To Mungo Park, 1795, and Richard Lander, 1830, who traced the Niger from near its source to the sea. Both died in Africa for Africa".

ON Oct. 5, the Duchess of York opened the Scottish National Memorial to David Livingstone at Blantyre. The memorial consists of the tenement house in which

Livingstone was born in 1813 and an adjacent building, and it is hoped to form a museum of personal relics of the explorer. The one-room 'house' in which Livingstone was born is much as it used to be, and original pieces of furniture have been lent by members of the family. The main object of the memorial will be to present the life of Livingstone in a series of pictures and tableaux. Of the £12,000 collected for the memorial, the main part has come from Scotland or from Scottish people overseas; £150 was contributed by the tribe of Chief Khama, whose father was a personal friend of Livingstone.

The abnormal warmth of September 1929 was maintained in the south-east of England up to the last day. At Greenwich temperature failed to reach 70° on five days only and reached 80° or above on six days. The following table shows the mean figures for this month, together with those for four other notably warm Septembers that have occurred since the record began in 1841:

Year.	Mean Maximum.	Mean Minimum.	Mean of Max. and Min.
1865	76·4°	53·7°	65·1°
1895	75·4	51·3	63·3
1898	74·5	51·3	62·9
1911	72·1	47·9	60·0
1929	75·5	53·3	64·4

The September of 1865 keeps its place as the warmest, although it was less than 1° warmer than last September. In 1911 the month began with intense heat, and gave the absolute maximum of 94·1°, while 1895 provided an extraordinary series of hot days late in the month, 80° being exceeded on six successive days, Sept. 23–28.

It is not surprising to find the temperature of the soil, even at a depth of 4 feet, abnormally high also. On the last day of the month it was well above 60° at a number of places; at Margate it was so high as 63·2°, at Brighton 62·6°, and at Falmouth 62°. To what extent this state of affairs may be expected to affect agricultural operations in the remainder of the autumn is a difficult matter to decide. Unusual dryness of the soil no doubt reduces its capacity for storing heat, and at Margate the rainfall for the year had amounted to only 6¾ in. up to the end of September, or 44 per cent of the normal. Heavy falls of cold rain quickly lower soil temperature, and a cold and wet October would no doubt dissipate nearly all the excess of accumulated warmth, especially in that considerable proportion of England where the recent rains have scarcely begun to restore the normal moisture content below the first few inches of depth. With average conditions, however, plant growth for the rest of this month will certainly be unusually rapid.

"The Authentication of Materials used in Research" was the title of the inaugural sessional address at the opening of the Pharmaceutical Society's School on Oct. 2, delivered by Prof. Henry Hurd Rusby, professor of materia medica at Columbia University, New York, who was on that afternoon presented with the Hanbury Memorial Medal for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs. Prof. Rusby selected as the text of his address the example of Daniel Hanbury, the namesake of the medal, whose habit it was to resort to extraordinary measures in his efforts to authenticate his sources of information. Varied examples of errors resulting from the incomplete description of new species and the failure to preserve type-specimens, led Prof. Rusby to the proposition that "it would not be going too far to decree that no report of research work in pharmacognosy, chemistry, pharmacodynamics or therapeutics shall be regarded as valid or given serious recognition, unless such report shall state where authenticated samples of the material employed have been permanently deposited". For botany and pharmacy there are the Kew Herbarium and the Museum of the Pharmaceutical Society, for therapeutics a beginning at least has been made by the adoption of samples deposited in named laboratories as international standards for biological assay. What of chemistry? The mass of chemical research proceeding daily in every civilised country gives rise to an endless number of new organic compounds which form the basis of new methods and new theories. To collect and classify, without any attempt at authentication, would be a colossal task. Controversies based on differences of material would be eliminated, a few reputations would be saved and maybe a few others lost; but whether the results would counterbalance the labour "admits a wide solution".

Photo-telegraphy and television are new industrial applications of science which make use of the ether. Being late-comers, they find that the earlier users of radio-communication have in all countries combined together to dictate the kind of waves that must be used in the ether. International laws and regulations have been made. The ether waves have been divided up into frequency bands, practically all of which have been allocated for various services. The authorities have little, if any, interest in the development of radio-optics. The present frequency band has a maximum breadth of 9000 cycles, apparently because this is the breadth of the band used in radio-telephony. We are glad, therefore, that Dr. James Robinson has in *Television* for October strongly protested against this monopoly of the ether. He points out that the common interests of those who are working or interested in radio-optics are the same. They should combine to improve the methods used in this science, and increase the facilities afforded for its development. If we ignore the factor of time, there is no fundamental difference in the principles of photo-telegraphy and television. In the latter case it is necessary to transmit a complete picture in less than a tenth of a second; the pictures succeeding one another as in a cinematograph, and thus giving the appearance of continuous motion. At present, organisations all over the world are working at this problem. At the recent radio exhibition at Berlin, the Baird, Karolus, and Mihaly systems were demonstrated. The German Post Office gave an excellent

demonstration of television. The stand of the Fernseh A.G., which showed the Baird system, was very popular.

THE twentieth annual Exhibition of Electrical, Optical and other Physical Apparatus is to be held by the Physical Society and the Optical Society on Jan. 7–9, 1930, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a Trade Section and a Research and Experimental Section, and in addition, a new section for the work of apprentices and learners is to be introduced. The Research and Experimental Section will be arranged in three groups : (*a*) Exhibits illustrating the results of recent physical research ; (*b*) lecture experiments in physics ; (*c*) historical exhibits in physics. The Exhibition Committee invites offers, from research laboratories and institutions and from individual research workers, of exhibits suitable for inclusion in any of the above three groups. Accommodation will be provided in rooms separate from those devoted to the trade exhibits ; and a part of the Catalogue will be devoted to their description. No charge will be made for space or catalogue entries in the Research and Experimental Section. Offers of exhibits, giving particulars of space and other facilities required, should be communicated immediately, and in any case not later than Oct. 30 to the Secretary, Exhibition Committee, 1 Lowther Gardens, Exhibition Road, London, S.W.7. The Section for Apprentices and Learners has been instituted with the object of encouraging craftsmanship in the scientific instrument trade. Apprentices and learners may exhibit, in competition, specimens of their work, providing they are in the regular employ of a firm subscribing to the prize fund which is exhibiting at the next Annual Exhibition, or has exhibited once during the past three years.

A PRELIMINARY notice of a World Poultry Congress, to be held at the Crystal Palace in July 1930, has been issued by the Ministry of Agriculture and Fisheries. The response to the British Government's invitation to the various countries of the world to participate in the Congress has been highly satisfactory, no fewer than 34 governments having already decided to take part. The Ministry is preparing a national exhibit for Great Britain and Northern Ireland, the keynote of which will be the demonstration of the high standard of excellence reached by the home small live-stock industries. The Ministry promises help to leading poultry and live-stock societies to enable them to exhibit effectively. It appeals to the public to become Congress members and to the breeders to contribute to the success of the section by exhibiting specimens. Forms of application for membership may be obtained from the World Poultry Congress Secretary, 10 Whitehall Place, S.W.1.

THE National Mark Scheme, which has already been applied to the sale of eggs, apples, and tomatoes, has been extended to English wheat flour as from Oct. 1. The scheme, which is described in the *Journal of the Ministry of Agriculture*, **36**, 513, is voluntary and open to all millers and packers, but only registered persons may use the grade designation marks prescribed. Application for enrolment can be made to the Secretary, National Mark Committee, Ministry of Agriculture, 10 Whitehall Place, London, S.W.1. Three grades have been prescribed, namely : (1) All-English Plain, (2) All-English Self-Raising, (3) All-English 'Yoeman'. Flour sold under these standard grades will be guaranteed as to type, flavour, and keeping qualities, and will not have been subjected to any chemical treatment. Under the conditions of registration, the packing premises, equipment, and records of any person employing the National Mark will be liable to inspection by an authorised officer of the Ministry of Agriculture, and samples of the wheat and flour may be required, so that the maintenance of a high standard of purity is assured. Besides offering advantages to bakers and consumers, the scheme should also benefit the arable farmer, who is at present experiencing great difficulty in obtaining a profitable market for his wheat.

THE University of Birmingham has issued a report on the work of its Mining Research Laboratory for the year 1928. With the support of the British Colliery Owners' Research Association, for some years a study has been made of the hydrogenation of coal, which shows that considerable variation occurs in the ease of attack and that commercial exploitation will probably demand the acceleration of the reaction by catalysts or otherwise. Aided by grants from the Miners' Welfare Fund, investigations have been made on spontaneous combustion and on the atmospheric conditions in deep and hot mines. These are cognate subjects of growing practical importance, as with the exhaustion of shallow seams the collier faces the difficulties of the deeper seams. The combination of heat and humidity is most embarrassing for those engaged in hard manual labour. It is interesting to learn that experiments are being made to dry the air of the mine with the aid of silica gel. Lastly, under the ægis of the Fuel Research Board, the physical and chemical survey of the Warwickshire Thick Coal is being pursued. The report shows that a considerable range of work is in progress on behalf of the mining industry, which has at its command much more scientific talent than might be inferred from the daily Press. Moreover, the results of careful study, such as is tabulated in this report, are frequently of immediate service to those concerned with the utilisation as well as the winning of coal.

PROF. H. L. CALLENDAR, of the Imperial College of Science and Technology, will deliver the Thomas Hawksley Lecture of the Institution of Mechanical Engineers on Nov. 1 at 6 P.M. He will take as his subject "Critical Relations between Water and Steam".

MR. J. REID MOIR has been elected president of the Ipswich Museum in succession to the late Sir E. Ray Lankester, in recognition of his services to science and prehistory and to the Ipswich Museum.

THE Norman Lockyer lecture for 1929 of the British Science Guild will be given by Sir Walter Morley Fletcher, who will speak on certain aspects of medical

research and their applications, on Tuesday, Nov. 19, at the Goldsmiths' Hall, Foster Lane, E.C.2. The Guild has also established an Alexander Pedler lecture in memory of Sir Alexander Pedler, for many years honorary secretary of the Guild. The lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler lecture will be delivered on Nov. 26 by Dr. G. C. Simpson, on "Past Climates". It will be held under the auspices of the Manchester Literary and Philosophical Society, 36 George Street, Manchester.

The following appointments have recently been made by the Secretary of State for the Colonies to the Colonial Agricultural Services: Mr. J. D. Gillespie, to be agricultural superintendent, British Guiana; Mr. C. W. Lynn, Mr. A. S. Thomas, and Mr. J. M. Ward, to be assistant superintendents of agriculture, Gold Coast; Mr. A. C. Maher, to be assistant agricultural officer, Kenya; Mr. P. W. T. Boughton-Leigh, Mr. A. E. Trotman, and Mr. R. Turner, to be superintendents of agriculture, Nigeria; Mr. R. Leach, to be mycologist, Nyasaland; Mr. W. M. Nutter, to be librarian, East African Agricultural Research Station, Amani, Tanganyika Territory; and Mr. R. W. Stuckey, to be agricultural officer, Uganda.

Notable additions to our knowledge of the natural history of South America are contained in the thirty-fourth volume of the *Anales del Museo Nacional de Historia Natural*, of Buenos Ayres, a bulky issue of 500 pages comprising contributions received from 1926 to 1928. The range of subjects dealt with is very wide, but specially noteworthy are the descriptions of a new genus of Glyptodon and other prehistoric animals from the Argentine, and an account of three new meteorites.

Applications are invited for the following appointments, on or before the dates mentioned:—Assistants at the Road Experimental Station of the Ministry of Transport at Harmondsworth—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Oct. 16). Two junior assistants for research work on blast furnace reactions at the Imperial College of Science and Technology—E. C. Evans, National Federation of Iron and Steel Manufacturers, Caxton House (East), Tothill Street, S.W.1 (Oct. 18). Junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Oct. 19). A "Wander" Scholar and Registrar to the Children's Department of Westminster Hospital—The Secretary, Westminster Hospital, Broad Sanctuary, S.W.1 (Oct. 21). An assistant lecturer and demonstrator in botany in University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff (Oct. 31). An Elder professor of anatomy and histology in the University of Adelaide—The Agent-General for South Australia, Australia House, Strand, W.C.2 (Jan. 1). A part-time lecturer in chemistry and experimental physics at Queen's College, London—The Secretary, Queen's College, 43/47 Harley Street, W.1. An assistant bacteriologist at the Rothamsted Experimental Station—The Secretary, Rothamsted Experimental Station, Harpenden. A draughtsman for the Survey Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1786). Two research assistants in the Department of Chemical Technology of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7.

Our Astronomical Column.

Suspected Variation in the Radial Velocity of Arcturus.—*Astr. Nachr.*, 5652, contains an article by Herr W. Schaub, of Bonn Observatory, in which he gives some measures that he has recently made of spectrograms of Arcturus taken by Prof. Kustner in the years 1904–1907 in the course of his investigation of the solar parallax from the radial velocities of stars. These spectrograms give some indications of an oscillation in the star's radial velocity, the range being about 0.2 km./sec. on each side of the mean, and the period 41 days. The range is too small for the result to be regarded as established, but Herr Schaub publishes the note in the hope that other spectrograms of the star may be examined.

Three Huyghens Lenses.—We owe to Huyghens the discovery of the true nature of Saturn's ring and of its brightest satellite Titan. A description by Profs. R. A. Sampson and A. E. Conrady of three long-focus lenses in the possession of the Royal Society (*Proc. Roy. Soc. Edinb.*, vol. 49, part 4, No. 23) is therefore of interest to astronomers. Their focal lengths are 122 ft., 170 ft., and 210 ft.; their apertures are $7\frac{7}{8}$ in., $8\frac{3}{8}$ in., and $9\frac{1}{8}$ in. The quality of the glass is very bad; besides numerous bubbles and black particles, there is a network of innumerable fine veins; but Huyghens's skill in figuring is stated to be very great. An eye-lens of $2\frac{1}{4}$ in. aperture and 6 in. focal length is also described and illustrated; the object glass was mounted on a high pole in such a manner that by pulling a string it could be brought into alinement with the eye-piece. It is noted in the paper that when the objective and ocular are both single lenses of the same kind of glass, and when the focus is adjusted for the orange-yellow rays, the chromatic faults of the combination are less noxious than is generally believed.

Rotation of Satellites.—*L'Astronomie* for September contains an illustrated article by M. E. M. Antoniadi on this subject. It includes a series of careful drawings of several of the satellites, showing their surface markings, their diameters, and their albedoes. It is pointed out that in many cases we know, either by surface markings or by periodic changes of light, that the satellite rotates in the same time as it revolves round its primary. This law is extended by inference and argument to all the satellites, with the possible exception of the very distant ones of Jupiter and Saturn. A drawing of Uranus, made with the great Meudon telescope in 1924, when the orbits of the satellites were seen almost edgewise, shows a system of belts on Uranus, very similar to those on Jupiter, and parallel to the direction of the satellite orbits. The article compares the case of the planet Mercury with that of the satellites, and shows that in this case also we should expect *a priori* that Mercury would rotate in 88 days, a fact which observation has now confirmed.

Research Items.

Antiquities from Lambay, Co. Dublin.—Some forty objects found during the building of a sea-wall on the island of Lambay in 1927, and presenting some remarkable features, are described by Prof. R. A. S. Macalister in Vol. 38, Sect. C, 8-9 of the *Proceedings of the Royal Irish Academy*. They belong to two different periods, the earlier being relics of a settlement, the later of an interment. The earlier series includes axe-, adze-, and hatchet-heads of grit, lance-heads of flint, flakes of flint, rings of limestone, sharpening hones, and fragments of pottery. In the later series are the umbo of a shield in bronze, fragments of a circular object with ornament of repoussé moulding, showing characteristic La Tène curves, an armlet with eight beads of bronze playing upon it, between each pair a flat disc of bronze, three ornaments from a sword scabbard, rings and fibulæ of Roman provincial type, and a fibula of Rhenish provincial military type; in iron, the fragments of a sword, and a circular mirror of classical type; a ring in lignite, and a few fragments of leather. In both series certain special points are noted. The earlier series belongs to a neolithic or bronze age settlement, but the types are remarkably exotic. The adze-heads predominate in a way not common in Ireland, and they are made of unusual material. The javelin heads are definitely of an Iberian type, differing from the flat lozenge-shaped javelins which have been compared to Iberian types. The large quantity of flint is surprising and points to a constant supply, which it is suggested is new and unexpected evidence of early trade. The interment series is also remarkable in indicating a community at the end of the La Tène period which had established relations with Romanised provinces in an unprecedented way. The mirror and fibulæ are new in Irish archæology. One fibula was evidently copied from another in the series by a workman who, though highly skilled, did not understand the mechanism of his model. The pin in the copy is fixed to the catch so that the fibula could not be used as a brooch. The two series "open doors that give us new vistas in Irish history".

Evolution of the Human Skull.—Prof. William K. Gregory continues his studies of the evolution of the human head from fish to man in *Quart. Rev. Biology* (June 1929, p. 233). The present article deals with the *norma basalis*, and leads to a series of findings of general interest. Thus the bony tracts of the skull appear to be moulded around and with reference to other structures which are frequently represented by fossæ in the dried skeleton. The form of a particular bone is partly determined by its position with reference to the midline of the skull, and to the axis and direction of locomotion, as well as by the stresses of gravitation and muscular contraction to which it is subjected. The increase or decrease of a bone affects neighbouring structures and tends to change the shape of the skull as a whole, but there appears to be some regulating mechanism, analogous to surface tension, which keeps the members of a functional series in line, particularly in the less differentiated stages. Occasionally it is found that over a long geological period a given element, such as the ectopterygoid, may be relieved of its functions and crowded out, illustrating change of function and the substitution of one part for another. But, although bones may be pushed apart or remoulded, they show a natural conservatism or inertia, so that many of them are retained throughout the whole series from fish to man, a conservatism more marked in the basal than in the lateral aspect.

California Sardine.—In *Contribution* No. 69 from the California State Fisheries Laboratory, Francis N. Clark describes a study of the weight-length relationship of this sardine (*Sardina cærulea*). He uses a mathematical 'factor' F, calculated from the formula $F = 1000W/Lx$, where W is the weight of a fish, and L its length; and x is the power to which L must be raised in order to express the relation between weight and length. From the data derived from material of four seasons, the value of x was found to be 3·15, but for the purpose in hand it was considered sufficiently accurate to assign the value 3·00 to x; that is to say, to assume that the weight increases exactly as the cube of the length. Clark concludes that the weight-length factor F is a reliable index of condition and reflects the fat content of the sardine. The value of F fluctuates from month to month, and differs from season to season. A useful bibliography is appended which brings together more than eighty references from the somewhat scattered literature on the subject treated.

Chinese Crab Naturalised in Europe.—In 1912, for the first time, a Chinese crab, *Eriocheir sinensis*, was found in the Aller, a tributary of the Weser, in Germany. There is no definite knowledge of its mode of arrival, but presumably it was transported by shipping. Its spread since 1912 has been rapid, as Dr. W. Wolterstorff has discovered (*The Aquarium Review*, September 1929). Shortly afterwards, it was discovered in the lower Elbe, and in 1923 had reached Hamburg. In 1927 it was observed on the coast of the North Sea from Ems to Büsum, in the Havel near Brandenburg, and in the Elbe north of Magdeburg. Since then it has continued its rapid multiplication and dispersal, so that the author now knows at least thirty-five places on the middle Elbe and its tributaries where it has been found. It seems not yet to have penetrated to southern Germany, but a look-out should be kept in rivers bordering the southern North Sea for this oriental, which threatens to colonise a wide area in Europe.

A Possible Relict Fauna in Sydney Harbour.—Occasional records of molluscs from Sydney Harbour have suggested that attempts are being made by tropical forms to establish themselves there. Hedley suggested that the occurrences were seasonal, that when the Notonectian flooded the port they gained a footing, but perished when the stream swung off the shore. These odd records were met with some distrust, but Tom Iredale now finds that a large unrecognised molluscan fauna exists in the Harbour, and of this he has described several new genera and species (*Australian Zoologist*, vol. 5, March 1929). The material was obtained from the dredger *Triton*, but since a load weighs 1250 tons, only a cursory survey of the material could be made, although it was sufficient to indicate that many new forms are still to be discovered. Recently two valves of *Hippopus hippopus* were found, and this, with the other records, leads the author to the suggestion that the fauna in question may be a relict fauna, a reminder (or remainder) of the times when Sydney Harbour enjoyed a tropical climate. This supposition has often been confidently put forward as a result of geological studies, but the time required from such data has always referred to an age much earlier than the apparent age of the collection of molluscs which has just been discovered.

Diptera of Patagonia and Southern Chile.—During the present year the British Museum (Natural History) has inaugurated a monograph which is intended to give a complete review of what is known of the Diptera of the forested region of South America and of the Patagonian plateau. It is intended to issue this work in six parts, and the subject matter is largely based upon collections made during a joint expedition arranged by the Museum in conjunction with the

acteriological Institute of the National Department f Hygiene, Argentina. The two collectors engaged pon the trip were Mr. F. W. Edwards, of the British luseum, and Mr. R. C. Shannon, who represented the acteriological Institute. The first part of the series o be completed deals with the craneflies and is by Dr. . P. Alexander, who finds that a considerable proportion of the genera and certain groups of species exhibit marked resemblance to Australasian forms—a fact lready appreciated in other groups of animals. Of art 2, only two fascicules have yet appeared. In asc. 1, Mr. A. L. Tonnoir discusses the Psychodidae, nd remarks that they form an aggregate which exibits great affinity with the Psychodid fauna of New ealand. He brings to light a new genus which he ames *Nemoneura*, while all but one of the species of he family enumerated by him are new to science. In asc. 2, Mr. F. W. Edwards deals with the Blepharoeridæ, and in the introductory part he discusses the ffinities, morphology, and classification of that amily. One interesting feature brought to notice is he presence or absence of mandibles in the females ithout the occurrence of species with these organs in n intermediate condition. The discovery of six new pecies of the most primitive known genus, *Edwardina*, is also of interest, together with an illustrated ccount of the larva and pupa.

The Gulf Stream.—A useful paper by Mr. H. A. Marmer on the Gulf Stream and its problems appears n the *Geographical Review* for July. Mr. Marmer races the history of our knowledge of the current nd refers to many recent investigations in the problems of its origin, course, and effect. It has now been shown that the course of the Gulf Stream from he Straits of Florida to Cape Hatteras is nearer nshore than it was formerly thought to be. In laces along this coast, it lies nearer to the 20-fathom han to the 100-fathom submarine contour. It has urthermore been found that the cool coastal waters long the eastern coasts of the United States, between he shore and the Gulf Stream, are not due to the abrador current, which from Nova Scotia southward oes not send south an inshore branch, at least as regular flow throughout the year. Observations ather confirm the belief that the waters of the abrador current, so far as they escape after contact ith the Gulf Stream, turn eastward across the tlantic. The cold inshore waters of the eastern oast of the United States are said to be due to land rainage, off-shore winds, and upwelling waters, and eflection by the earth's rotation of cold water from he Gulf of St. Lawrence.

Aerial Survey in Alaska.—Extensive experiments n aerial photographic surveys were made by the nited States Geological Survey in south-eastern laska in the summer of 1926. The choice of area as decided both on account of the need of maps for orest, mining, and fishing interests, and by reason of he numerous waterways which provided easy access nd landing-places for the aeroplanes. Three machines ere employed, and in rather less than three months, uring which there were many unfavourable days, an rea of about 10,000 square miles was photographed. rints were made from approximately seventeen housand negatives. The aeroplanes flew to and fro, ollowing lines as near as possible at right angles to he shore lines. A spacing of three and a half miles etween adjoining lines was found to provide sufficient verlap in the pictures. The altitude of the aeroplanes was about 10,000 feet. An account of the ork, with a specimen sheet of the map, is contained n *Bulletin* 797 E of the United States Geological urvey, by Messrs. R. H. Sargent and F. H. Moffit. he maps are preliminary sheets and of course without contours. They will serve as base maps for geological surveys that are planned for the region, but are subject to correction when more accurate horizontal control is obtained. But until this additional field work is undertaken, the aerial survey maps may be regarded as useful preliminary sheets.

The Rhineland Earthquake of 1929.—The results of an investigation of the records of the Rhineland earthquake of Dec. 13, 1928, have been published by B. Gutenberg (*Gerlands Beiträge f. Geophysik*, 23, p. 22 ; 1929). The focus was situated near Rödingen and the focal depth is thought to have been about 30 km. The longitudinal waves were propagated in the upper, intermediate, and lower layers, with velocities respectively $Pg = 5{\cdot}6$, $P^* = 6{\cdot}7$, and $P = 8{\cdot}2$ km./sec. The values for Pg and P^* agree well with those found by Jeffreys from the Tauern and other Central European earthquakes, but the value for P is considerably higher than Jeffreys' value 7·7 or 7·8. Conrad has previously deduced $P = 8{\cdot}12$, though he, too, found $P = 7{\cdot}83$ for the Tauern earthquake. There appear, therefore, to be real differences between adjoining regions of the upper parts of the lower layer. The possibilities of further complications are suggested by R. Schwinner (*ibid.* p. 35), who infers from gravity measurements that there are sheets of heavy 'sima' rising up nearly to the surface through dislocations between the blocks of 'sial' corresponding to the Alps and the Bohemian massif.

Geology of Uganda.—The Annual Report of the Geological Survey of Uganda for 1928 (Entebbe, 1929) is a particularly interesting document. It contains a general description by A. D. Combe of the Bufumbiro volcanic area, notes on the leucite and other lavas of which were given by W. C. Simmons in the Annual Report for 1927. The discovery of large areas of moraines and fluvio-glacial deposits at the foot of Mt. Sabinyo is also recorded. Further information is given of the cassiterite deposits of Murisasando, and their association with quartz veins, pegmatites and muscovite-kaolin veins. There are already indications of several petrographic provinces in Uganda : leucite-lavas of Bufumbiro ; augite-nepheline lavas of Elgon in the east ; hypersthene-dolerite dykes ; and granites of many types, including enstatite-granites in Karamoja and the better-known tin-bearing granites. At the Seismological Observatory records have now been made for a first complete year, and it has been possible to get time signals on a short-wave wireless set. Details of the shocks recorded are given. The Research Notes, which form a welcome feature of the report, deal with the geological history of the Great Lakes (E. J. Wayland) ; rock cisterns and prehistoric man (E. J. Wayland) ; augite crystals from the Belgian Congo portion of the Bufumbiro volcanic field (A. D. Combe and W. C. Simmons) ; and oscillations of lake level (W. C. Simmons). The officers of the Survey are to be congratulated on a successful and stimulating year's work.

The Hydrogen Molecule.—A recent paper by Prof. O. W. Richardson and Dr. P. M. Davidson, in the *Proceedings of the Royal Society* for August (vol. 125, p. 23) illustrates the very considerable extent to which the analysis of the complicated band spectrum of hydrogen has already proceeded. Many of the electronic energy levels for the molecule H_2 are now known, together with the associated vibrational and rotational changes in energy, and one of the important results obtained in the present paper is that the data for the energy functions of the more stable H_2 molecules obtained by two essentially different methods are sufficiently consistent to show that the analysis of the spectrum has progressed along sound lines. Other points considered are the potential energy of the molecules in the neighbourhood of

equilibrium positions of the two nuclei, the total energy of the molecules and the ways in which they dissociate, the kinetic energy of the electrons in the molecule, and the comparison of the states of the H_2 molecule and of the H_2^+ molecular ion. Attention is also directed to a mistake in the standard "Report on Molecular Spectra in Gases", and this is corrected in an appendix upon "The Mean Kinetic Energy of a System of Particles in Motion under their Mutual Forces, some of the Particles being held fixed and the others remaining in their neighbourhood".

Counting Ionising Particles.—Considerable attention is now being given to the improvement of electrical methods for detecting swift ionising particles. The old electrical methods, and one new one devised by Prof. Geiger, consisted essentially in the amplification of the ionisation due to a single particle by electrical fields within the ionising chamber. The majority of the new methods aim at making use of the initial ionisation without such magnification. One way in which this can be done is exemplified by the arrangement of Hoffmann and Pose (*Zeitschrift für Physik*, Band 56, p. 291), in which the ions are collected and registered in their original numbers by a very sensitive electrometer. This has several disadvantages, and a more promising line has been developed, largely in the Radium Institute at Vienna. The ions are again collected as a saturation current, but the potential changes brought about at the grid of a valve by their reception are amplified by other valve systems until they are large enough to be measured by less sensitive instruments. The circuits used differ somewhat from those which are most familiar in high frequency technique, since the input voltage is impulsive in this case, and numerous difficulties had to be overcome before the present arrangements were adopted. These do, however, appear now to be very satisfactory, and an investigation of natural H-particles has already been made with the new 'valve electrometer', by E. A. W. Schmidt and G. Stetter (*Zeitschrift für Physik*, Band 55, p. 467), which has revealed an interesting discrepancy between the numbers of particles recorded electrically and by the counting of scintillations, only about half the number found by the latter method being detectable by the former.

Standard Cells.—The August number of the *Journal of the American Chemical Society* contains two papers by Prof. G. A. Hulett and W. S. Niederhauser dealing with polarisation and hysteresis in standard cells. Although previous work had indicated that such cells were subject to considerable polarisation, even at relatively low currents, the analysis of the effect between the two electrodes had not been adequately studied. The first paper deals with the polarisation of the individual limbs of the saturated, unsaturated, and acid cadmium cells and of the zinc cell at very low currents. The effects of charging and discharging the cells were studied. The results show that most of the polarisation occurs in the mercury limbs; that the effect of charging is more severe at the mercury electrode; whilst that of discharging is more severe at the amalgam electrode; and that a recovery effect, present only in the mercury limb of the cell, appears when the polarisation occurs at the higher currents and tends to decrease the polarisation of the cell. No noticeable change in the resistance of the cell accompanies polarisation. A large number of important experimental results is accompanied by a discussion. In the second paper the adjustment of the individual limbs of standard cells to temperature changes is considered. New cells show high values of hysteresis, which decrease during the first month or so and are probably due to overheating in the course of construction. A method of avoiding this trouble and of setting up cells which give normal values within a few hours of construction is described.

The Night Sky.—The June issue of the *Journal de Physique* contains an account of an extensive series of observations upon the spectrum, colour and polarisation of the light from the night sky, by J. Dufay, of the Observatory of Lyons. The work has been done almost entirely with calibrated photographic plates, and is essentially quantitative. M. Dufay has studied both the green auroral line and the continuous spectrum, and finds that the former carries about one quarter of the total radiant energy between 5000 A. and 6000 A.; after allowing for the auroral line, the residual light has a distribution of energy which is more nearly like that of sunlight than that of the blue sky, although it is relatively stronger in the longest and the shortest visible wave-lengths. M. Dufay finds that the light from the night sky is definitely polarised, with the privileged plane passing through the sun, but that the extent of the polarisation—about three per cent—is decidedly less than that of the zodiacal light. He concludes that the light comes partly from feeble stars and the permanent aurora, and partly from atmospheric diffusion and zodiacal light, but that these factors do not account for more than about one-half of the total radiation, the origin of the remainder of which has still to be found.

Ignition of Firedamp.—Although a number of firedamp explosions have been attributed to frictional sparks or heating caused by picks or working machinery, experience and earlier research work have shown that it is very difficult indeed to cause ignition by such means. In a paper (No. 54, H.M. Stationery Office, price 6*d*.) issued by the Safety in Mines Research Board, Mr. M. J. Burgess and Prof. R. V. Wheeler have described further experiments carried out with sparks produced by the abrasion of steel by revolving wheels and also with an ordinary chain coal-cutting machine working against a built-up mass of rock in explosive atmospheres. The results show that, with certain kinds of rock, firedamp could readily be ignited, although it is not certain whether ignition was caused by the sparks emitted or by the heating of the rock surfaces caused by the impact of the coal-cutter picks. These results are obviously of importance in connexion with the use of such machines in mines where firedamp occurs and the paper is a valuable contribution to the literature of safety in mines.

Low-Expansion Nickel Steels.—For clock pendulums, standard tapes for geodetic surveys, standards of length, scientific instruments where variations in size due to changes of temperature are to be minimised, and for other purposes, a 36 per cent nickel-iron alloy is in general use and most of the credit for the development of the iron-nickel alloys is given to Guillaume and his co-workers. The alloys, however, have been the subject of extensive researches, and in *Engineering* for Sept. 27, Mr. T. F. Russell discusses two theories of this alloy and gives results from experiments carried out in the Research Laboratories of the English Steel Corporation, Limited, Sheffield. The theories are due to Benedicks and Honda, but having considered their respective views, Mr. Russell says he is convinced "that in order to explain the variations in expansibility, magnetic induction, hardness, etc., which may be brought about in this alloy by suitable treatment, much more profound theories, probably based on interatomic relations, will have to be propounded". Results are also given of an investigation of the alloy known as 'nilex', made with the view of correlating the coefficient of expansion, Brinel hardness and magnetic induction, the article being accompanied with curves and a description of the apparatus used in the research.

The Physiology of Vision.

As in other branches of science, academic knowledge of the physiology of vision is finding its practical applications in many fields to-day. The importance of the eye as an optical instrument and of the correction of errors of refraction is obvious, but on the response of the organ to variations of illumination and on the degree of visual acuity attainable under different conditions of lighting depend the ease and correctness with which a variety of different tasks can be carried out. There need only be mentioned the lighting of mines and factories, or driving or flying by night. The adaptation of the eye to varying degrees of illumination, including its response to sudden changes in the amount of incident light, is therefore a subject of considerable practical importance; and two recently published monographs have been designed to collate and to increase our knowledge of this question.[1]

It is well known that the sensitiveness of the eye increases in the dark: the degree of this increase depends on the intensity of the light to which it was previously exposed and the time allowed for dark adaptation before the sensitiveness is measured; the increase may be several thousand times the initial sensitiveness and the maximum is reached in about 20-30 min., although it may still increase slowly over a period of several hours. In the dark-adapted eye the chromatic threshold is above the achromatic, so that a coloured light is first seen achromatically and appears coloured only when the intensity is raised. The colourless interval increases with progressive dark adaptation owing to the fall in the threshold for achromatic stimuli, or, in other words, owing to the increased sensitiveness. The interval is greatest for light of short wave-length: it is doubtful if it exists at all in the case of the extreme red end of the spectrum. Thus adaptation is greatest for blue light, least for red. When adaptation is followed in different regions of the retina, it is found that it is very slight at the fovea, the point of central vision, and the maximum increase in sensitivity is reached here in the first 5-15 min. in the dark: the greatest adaptation occurs in the peripheral regions of the retina, especially at 10°-15° from the fovea. It is not certain whether adaptation at the fovea is the same for all light or greatest for blue as at the periphery.

The course of dark adaptation is influenced by such factors as the age of the subject, the adaptation of the opposite eye, and the administration of drugs. There is a definite relationship between the size of an object and the illumination required to render it visible, which varies with the state of adaptation and the area of the retina stimulated: the minimal light stimulus has been found to be about $1 - 10 \times 10^{-10}$ ergs in different experiments. In dark adaptation, the subjective luminosity of the spectrum is greatest in the green instead of in the yellow as in the light-adapted eye. The course of dark adaptation is also altered in pathological conditions, such as colour-blindness, night-blindness, and other diseases of the organ.

Examination of the excised eye shows that certain structural changes occur in the retina in dark adaptation: the granules in the pigment epithelium between the rods retract in the eyes of cold-blooded animals, but a similar movement has not been observed in warm-blooded; the cones extend and the rods decrease in size, whilst minute changes can be observed in the nerve cell nuclei. It must also not be forgotten that the pupil alters in size with the intensity of the light shining upon the eye: this alteration in turn influences the visual acuity and the course of dark adaptation; it is therefore advisable to use an artificial pupil to obviate these effects, when studying dark adaptation. The reaction time of the iris is sufficiently slow to permit of a bright light entering the dark-adapted eye in excessive intensity, giving rise to glare: the pupil then constricts and limits the amount of light entering and the eye becomes light-adapted, or dark-adapted again, if the exposure to light was only momentary.

Certain chemical changes have been observed in the eye under different conditions of illumination: thus the retina becomes acid and the visual purple is bleached on exposure to light. This pigment is associated with the rods and probably not at all with the cones. It is easily bleached by organic solvents and acids and alkalis: it is soluble in bile salts, but insoluble in water. The curves of its energy absorption, and of its bleaching by spectral light, and the luminosity curve of the dark-adapted eye, are almost identical, indicating that it must be of great importance in twilight vision and that its regeneration is probably the basis of dark adaptation. It is possible that delay in its regeneration is the cause of night-blindness: and recent work suggests that a deficient intake of vitamin A is the ultimate cause of this delay.

It must also be mentioned that electrical responses can be obtained from the eye when stimulated by variations of the illumination: two groups can be distinguished, the responses in the optic nerve, similar to those in other sensory nerves, and the retinal currents. Examination of these responses has suggested that the retinal processes leading to excitation may consist of a primary change, coinciding with the flash of light and giving rise to a product proportional in amount to the quantity of light received, and also of a secondary change, leading ultimately to excitation of the nervous structures, the rate of which is a linear function of the amount of light product formed in the primary change.

It is now generally held that the cones of the retina are the end organs stimulated by light in the light-adapted eye, whilst the rods function similarly in twilight vision: dark adaptation, then, is the shifting from the cone to the rod mechanism. During the early stages the increase in sensitivity is slight, the cones are still functioning: then the rod mechanism comes into play and the sensitivity increases markedly. It has been suggested that the visual purple is only slowly regenerated and that this accounts for the slow onset of the rapid increase in sensitivity. F. Allen (*Jour. Opt. Soc. Am. and Rev. Sci. Instruments*, vol. 13, p. 383; 1926), however, has adduced evidence against this theory: he found that it was possible to enhance or depress the sensitiveness of the visual receptors, reflexly, by illumination of either the same or the opposite eye. The weaker intensities produce depression and stronger enhancement; but the strongest enhance or even depress only the response to their own colour, the remainder being depressed or enhanced respectively: with certain intensities and colours the two processes balance each other. Allen suggests that these reflex effects must be taken into consideration in any theory of dark adaptation.

In their work on the critical frequency of flicker, Lythgoe and Tansley kept both eyes of the subject in the same condition of light adaptation in order to avoid any reflex effects from one eye to the other. The left eye was used throughout and the flicker was

[1] Medical Research Council. Special Report Series, No. 127: Reports of the Committee upon the Physiology of Vision. 2: Dark Adaptation (a Review of the Literature). By Dorothy Adams. Roy. 8vo. Pp. 138. 5*s*. net. Special Report Series, No. 134: Reports of the Committee upon the Physiology of Vision. 5: The Adaptation of the Eye; its Relation to the Critical Frequency of Flicker. By R. J. Lythgoe and K. Tansley. Roy. 8vo. Pp. 72. 2*s*. 6*d*. net. (London: H.M. Stationery Office, 1929.)

observed at the fovea and at several points in the periphery at fixed degrees from it. It was found that during dark adaptation, with high degrees of illumination of the (flickering) test patch, the critical frequency of flicker fell in all regions of the retina but especially at about 10°-50° from the fovea : with low illuminations there was still a fall at the fovea, but a rise was observed in the periphery, in which region, with intermediate illuminations, there was first a fall and then a rise. When red light was used to illuminate the test patch, the critical frequency fell at the periphery with intensities of illumination which would have given a rise if white light had been used.

It is considered probable that the fall in critical frequency is a function of the cones, whilst the rise is associated with the rods. When the brightness of the surrounding field was varied, it was found that there was a fall in critical frequency at the fovea with an increase or decrease of the field brightness above or below that of the test patch. At high illuminations, lowering the field brightness lowered the critical frequency at the periphery more than at the fovea : at low illuminations the critical frequency, at the periphery, was brightest with dark or feebly illuminated surrounding fields. These changes in the critical frequency are considered to be due to the adaptation of the cones and the rods respectively : the authors consider that there is some evidence that the peripheral cones do not function in quite the same manner as those at the fovea.

Whales and Whaling.

WHEN, in 1919, Sigurd Risting became secretary of the Norwegian Whalers' Association, he began to collect all available statistics of catches and measurements of whales and whale fœtuses in order to throw as much light as possible upon the life, migrations, and conditions of growth of these animals. To this end, a schedule of relevant questions was sent with the various Norwegian whaling expeditions to the antarctic seas. In this way, measurements of 7750 blue whales, 6919 fin whales, and 1054 fœtuses (592 blue whale and 462 fin whale) have been obtained from the whaling fields of South Georgia, South Shetlands, and South Orkneys. In addition, from the year 1922 onwards, statistics have been sent to Risting from practically every Norwegian whaling company throughout the world, and a few foreign companies also have contributed. From this mass of statistical material much valuable information regarding both blue and fin whales has been deduced.[1]

It is shown beyond all doubt that both the above species of whale in the antarctic seas undertake more or less regular annual migrations, retreating northward to more temperate waters in the winter and returning southwards in the summer months of the year. By the beginning of September, the whales, both blue and fin, begin to appear in the southern whaling fields. At the commencement of the whaling season (October–April), the blue whale generally predominates, the main body of this species usually arriving somewhat earlier than that of the fin whale. In the month of May, the bulk of the whales leave the whaling fields, but a few of both species appear to remain throughout the winter. When they leave the southern fields, the whales begin to appear in large numbers off the west coast of Africa, where a number of whaling stations are now in operation. Further, it appears from the statistics that the blue whale migrates farther north than the fin whale.

Hitherto, information relating to the size of whales has been derived from isolated measurements of a small number of individuals. Risting's figures, therefore, systematically drawn from a large number of animals over a number of years, supply the first really accurate information on this point. The average length of a blue whale is found to be, in the southern hemisphere, 23·68 metres in the case of the male, and 24·72 metres in the case of the female : animals exceeding 31·38 metres (100 ft.) are seldom caught. In the case of the fin whale the corresponding sizes are 20·40 metres, 20·98 metres, and 27·3 metres (87 ft.) respectively. In the northern hemisphere, however, the average size of both species is considerably less.

[1] Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions. Vol. 50 : Whales and Whale Fœtuses ; Statistics of Catch and Measurements collected from the Norwegian Whalers' Association, 1922–25. By Sigurd Risting. Pp. iii+122. (Copenhague : Andr. Fred. Høst et Fils, 1928.) n.p.

Proceeding to a consideration of the statistics relating to oil production, Risting has been able to make out the following table of the relative values of different whales in terms of the average yield of oil per animal : 1 blue whale = 2 fin whales = 2½ humpbacks = 6 seis in the same whaling region. The blue whale yields on an average 84-87 barrels of oil per animal in the southern hemisphere, and 60-64 barrels in northern seas. (Six barrels of oil = 1 ton.)

After a detailed analysis of the statistical material relating to whale fœtuses, Risting arrives at the following conclusions : (1) In the case of both blue and fin whales, pairing takes place practically throughout the year in both hemispheres. (2) The majority of pairings, however, take place in June, July, and August, in the southern hemisphere, that is, during the winter months when the animals are in more temperate waters. (3) In the northern hemisphere the majority of pairings take place between the middle of December and the middle of March. Thus the majority of pairings in northern and southern seas are found to take place in the corresponding winter months. (4) Both blue and fin whales reach puberty in the course of their second year, the period of gestation is roughly one year in both cases, and the female, therefore, does not as a rule produce young every year.

Sir Sidney Harmer[2] has brought together all available facts bearing upon the probable future of the whaling industry in the presidential address delivered by him last year to the Linnean Society. A historical survey of whaling operations in connexion with each species of whale which is, or has been hunted, is followed by an account of modern whaling and whaling methods. At present whaling operations are based mainly on rorquals, the species of practical importance being the blue, fin, sei, and Bryde's whales. Statistics relating to the various fields at present worked, including the antarctic area, Africa, Australia and New Zealand, South and North Pacific, and North Atlantic, are given. From these figures it is shown that by far the most important field is the first named, which, in the season 1925–26, yielded no less than 779,167 barrels of oil derived from 13,997 whales. The total oil production of all other localities in the same season was only 402,724 barrels, drawn from 12,965 whales. The total number of whales destroyed, however, was, without doubt, considerably in excess of this number, as many are killed which are not recovered, and it is probable that at least 30,000 individuals perished in this single season.

Sir Sidney is confident that the present rate of killing is too high. History has shown that whaling

[2] "The History of Whaling." By Sir Sidney F. Harmer. Presidential Address delivered at the Anniversary Meeting of the Linnean Society of London on the 24th of May 1928. Pp. 51-95. (London : Linnean Society, 1928.) 1s.

perations in the past have been responsible for a very erious reduction in the number of whales. As a oncrete example, the case of the southern right hale is cited. This whale, once inconceivably numer-us in southern seas, has been so reduced in numbers hat a regular industry based upon it is now no longer arried on. But, high as it is, the present rate of illing will in all probability be far exceeded in suc-eeding years as more up-to-date methods of capture, flensing', and extraction of the oil are introduced nd perfected. In the absence of preventive measures, herefore, Sir Sidney Harmer holds that the hunted pecies are in grave danger of becoming so reduced in umbers that they may with difficulty escape ex-nction. To the Discovery Expedition, at present in-estigating the habits of life and ecology of whales in ntarctic seas, he looks for definite information as whether or not this danger is a real one. Should ich prove to be the case, it is hoped that whalers ill unite with naturalists in seeking some method by hich such an untoward result may be averted.

G. A. S.

New Observatory of the University of London.

THERE are already observatories at the Imperial College of Science and Technology, University ollege, and the Drapers' Company Transit House, but here was felt to be need for further opportunities in he University of London for research work. Prof. . N. G. Filon and Mr. C. C. L. Gregory were fortunate receiving an offer from Mr. J. G. Wilson of the 4-inch reflecting telescope with which his father, Ir. W. E. Wilson, carried out many useful researches t Darramona, Ireland; the only condition attached the gift was that the University should erect a itable building for it.

The Hendon Urban District Council offered a site pposite Mill Hill Park, which has been leased to the niversity for 999 years at a nominal rental. The enate of the University voted £5000 for the building, nd four London colleges with the London School of conomics voted annual subsidies towards its main-enance. The building being near a main road, vibra-on of the soil gave some trouble, but this was cured y filling the space round the pier with coke breeze. new guiding telescope with a six-inch objective by ooke (focal length, 11½ feet) was attached to the quatorial; the guiding eyepiece was mounted on a icrometer and position circle, to enable the telescope follow moving objects. An 18-foot dome was con-ructed by Messrs. Cooke, Troughton and Simms, td.; this has electrical driving, which can be controlled ther from the floor or the eye-end. The Observatory as also a 10-foot Rowland grating spectrograph, fed y a cœlostat by Cooke, which can be adjusted either r solar or stellar work.

Prof. Filon is the Director of the new Observatory, nd Mr. C. C. L. Gregory has the title of Wilson bserver. Students in the Faculty of Science in all he colleges of the University will be able to study at he Observatory, and facilities will be given for the vestigation of new observational methods.

The general public will be permitted to view the bservatory on two afternoons in each month, except om July to September; ratepayers of Hendon will casionally be admitted at night (two evenings per onth from October to March) on making written pplication to the Director.

The Observatory was opened and the Wilson lescope unveiled by Sir Frank Dyson, the Astronomer oyal, on the afternoon of Tuesday, Oct. 8.

University and Educational Intelligence.

THE study of biology in the universities was one of the two subjects discussed at the annual conference of the universities of Great Britain and Ireland, held this year at the London School of Economics on May 11. One of the questions dealt with was whether the universities are sufficiently active in promoting the study of biology, and this part of the discussion was focused mainly on an appeal from the Colonial Office for university trained biologists competent to deal with the biological problems continually arising in the economic exploitation of the resources of various parts of the Empire. Commenting on this, Prof. G. N. Watson, of University College, London, emphasised the fact that for such work the narrow specialist is quite unsuitable, the problems in question being incapable of solution without wide knowledge and lively imagination. He outlined an appropriate four years' honours course. Prof J. Arthur Thomson and others directed attention to the necessity of providing in universities at least three separate courses in biology appropriate, respectively, to the requirements of the medical student, the arts student, and the student intending to specialise later as biologist. The report of the proceedings of the Conference, including the discussion of the other subject dealt with, namely, university entrance requirements and, in relation thereto, the curricula of the last two years of school, has recently been published by the Universities Bureau of the British Empire, 50 Russell Square, W.C.1 (1*s*.).

THAT the barriers between commerce and public service are breaking down was illustrated on Oct. 7 by the visit of the Lord Mayor of London to perform the opening ceremony of the new extension of Messrs. W. and G. Foyle, Ltd., in Manette Street, almost adjoining the older bookshop in Charing Cross Road. The new building is on the site of the old Goldbeaters' House mentioned by Dickens in "The Tale of Two Cities", and consists of six floors, providing accommodation for nearly two million books. A great bookshop such as Messrs. Foyle have built up during the past twenty-five years is something more than a commercial undertaking or, like Dr. Johnson's brewery, the potentiality of growing rich beyond the dreams of avarice; and this the firm have proved by their public literary lectures, the department of education films, and the demonstrations of new and classical music. Their public responsibility also extends to the destruction of worthless books, the number of which, we are told, amounts to ten thousand per week. Further, the machinery which Messrs. Foyle have established gives an assurance that accumulations of books of which executors and others have to dispose shall reach the hands of students and become again *fabrilia fabris*. That this is recognised throughout the world is demonstrated by the firm's morning mail, which in the busy season amounts to more than four thousand, and the number of books purchased is two and a half million a year. At the opening ceremony, literature was represented by Mr. W. B. Maxwell, who assumed the white sheet as representing the profession which filled these vast bookshelves; but Sir Godfrey Collins, representing the publishers, stated that his firm only publish three books out of a hundred manuscripts submitted. Messrs. Foyle's education department is especially strong with two hundred thousand volumes and accommodation for five hundred persons; and the same may be said of the periodical department, which claims to supply the back numbers of almost any periodical. The history of the firm is recounted in a book, "The Romance of a Bookshop, 1904–1929", by Gilbert H. Fabes, specially published for the opening ceremony of the new extension.

Calendar of Patent Records.

October 12, 1849.—The ordinary wire safety-pin was patented by Charles Rowley, button manufacturer, of Birmingham, on Oct. 12, 1849. Though pins of this kind were apparently not known at that time in the pin-making industry, there was little novelty in the invention, for similar pins were in common use in Roman and earlier times. The earliest known is one in the British Museum belonging to the Mycenean period, *c.* 1000 B.C., which is of almost identical construction.

October 14, 1568.—What appears to be the first Irish industrial monopoly patent was granted for twenty-one years to Peter Backe, a native of Flanders, on Oct. 14, 1568. The grant was to enable the patentee to collect madder in all parts of Ireland and to dye skins of animals.

October 14, 1801.—The specification of the patent granted to William Symington on Oct. 14, 1801, describes the engine and machinery of the *Charlotte Dundas*, which was one of the first practicable steamboats. The boat was constructed for Thomas, Lord Dundas, who was interested in the introduction of steam for canal navigation, and in March 1803 towed two loaded barges on the Forth and Clyde Canal for a distance of 19½ miles. On another occasion the vessel carried Robert Fulton, who a few years later, in America, initiated the first commercial steamboat service.

October 14, 1831.—The first complete bread-making machine was patented by John Cowderoy, of Hoxton, on Oct. 14, 1831. The apparatus, which was manually operated, consisted of the combination of a dough-mixing machine, a moulding machine, and mechanism by which the moulded loaves were run into the oven, without being touched by hand.

October 15, 1907.—Bakelite, an insoluble and infusible condensation-product of aldehyde and phenol, was invented by L. H. Baekeland and was the subject of a United States patent applied for by him on Oct. 15, 1907. Bakelite is not so flexible as celluloid, but it is more durable, stands heat, does not smell, does not catch fire, and is a bad conductor of heat and electricity.

October 17, 1691.—On Oct. 17, 1691, Edmund Halley, the astronomer, was granted a patent with other persons "to exercise and practice their new invention or engine whereby by conveying aire into a diveing vessell they can maintaine severall persons at the same time to live and worke safely under water at any depth for many houres for the retreiveing and regaining of gold, silver, bullion, money, and all manner of goods wreckt and lost at sea." The diving-bell was constructed of wood covered with lead, and the air was to be renewed through flexible connexions from weighted barrels lowered by the side of the bell.

October 17, 1850.—The Scottish shale-oil industry was started under the patent granted on Oct. 17, 1850, to James Young for his invention for "treating bituminous coals in such a manner as to obtain therefrom an oil containing paraffine (which I call paraffine oil) and from which oil I obtain paraffine." Samples of the oil were shown at the Great Exhibition of 1851 and aroused great interest, and in the same year works were opened at Bathgate by Young in conjunction with Edward Meldrum and E. W. Binney. The process was completely successful, paraffin oil being produced at 5s. a gallon, a great boon in the days when oil lamps were still the main source of illumination. The patent was many times attacked, but remained secure and ran its full course.

October 17, 1855.—Oct. 17, 1855, is the date of the first of the many patents granted to Sir Henry Bessemer in connexion with his famous process for the manufacture of steel from cast iron. (Cf. Calendar of Patent Records, Sept. 22.)

Societies and Academies.

LONDON.

Society of Public Analysts, Oct. 2.—H. E. Cox: Chemical tests in relation to fur dermatitis. Para-phenylenediamine is the most frequently used of the intermediates employed for dyeing furs and is also the most toxic. The so-called Bandrowski's base is not a fast final product; it is easily reduced, and then re-forms *p*-phenylenediamine, and so may be an indirect cause of irritation. It also appears to be associated with some partly oxidised *p*-phenylenediamine, which can be detected chemically.—**J. H. Coste**: A nomogram for use in gas analysis. By the use of this nomogram the necessary corrections of temperature can be made over a reasonable range of temperature, with sufficient accuracy for many purposes.—**P. S. Arup**: The composition of Irish winter butter. Analyses are given of 580 undoubtedly genuine samples of butter obtained from creameries and agricultural schools in the Irish Free State during the winters of 1927–28 and 1928–29. In the former period 50 samples showed Reichert-Meissl values below 24; in the latter period 88 samples. In places where calving was not confined to one season of the year (as is generally the case in Ireland), and also where the conditions of feeding and shelter were superior, Reichert-Meissl figures below 26 were not obtained.—**W. R. Schoeller and H. W. Webb**: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. (16) Observations on tartaric hydrolysis. (17) The quantitative precipitation of the earth acids and certain other oxides from tartrate solutions. Precipitation of tantalic, niobic, and tungstic acids from tartrate solution by hydrochloric or nitric acid, though specific, is never quite quantitative. Only titanium and zirconium interfere to a certain extent with the normal course of the reaction. The earth acids and their mineral associates are classed into analytical groups according to their precipitability from tartrate solution.

GENEVA.

Society of Physics and Natural History, July 4.—A. Naville: (1) The action of the mitogenetic rays through a quartz screen (preliminary note). The author shows that onion roots, placed behind a quartz filter, are capable of producing kineses in the cornea of a frog. An exposed cornea showed from 36·4 per cent to 44·9 per cent more kineses than a cornea not exposed (exposure from one to two hours). (2) Sexualisation of the gametes and gonomery in the Myxosporidæ (preliminary note). Three different sex types exist in the Myxosporidæ, which can be attributed to the more or less great precocity of sexualisation of the germinative strain. The delay in sexualisation admits of isogamy as an extreme case, which, in fact, is met with in the Microsporidæ. The acceleration of the sexualisation leads to diœcia. In the Actinomyxidæ a very precocious sexualisation is found. The author confirms by another method his earlier results on the gonomery of the zygote.—**R. Wavre**: New researches on the planetary figures to the second approximation. The gravitation on the polar axis is expressed by the following formula (ω = angular velocity):

$$g_0 = iMt^{-2} + \omega^2 g_{0,1} + \omega^4 g_{0,2}.$$

The difference between the moment of inertia with respect to the polar axis and the moment of inertia with respect to an equatorial axis is

$$i(C - A) = \omega^2 K_1 + 2\omega^4 \lambda K_2.$$

The terms in ω^4 represent the difference between the second and the first approximation.

Washington, D.C.

National Academy of Sciences (*Proc.*, vol. 15, No. 7, uly 15).—**J. H. Van Vleck** and **Amelia Frank**: The ean square angular momentum and diamagnetism the normal hydrogen molecule. A mathematical scussion.—**Alvin B. Cardwell**: Effects of a crystal- graphic transformation on the photoelectric and ermionic emission from cobalt. The specimen was owly and thoroughly 'outgassed'. Marked changes both photoelectric and thermionic emission occur about 850° C., when there is a change from hexagonal ose packing to the face-centred cubic form. There ems to be an intermediate structure which is much ore sensitive than the stable forms; the effect is ore marked with descending than ascending tem- eratures.—**Paul R. Gleason**: The reflecting power some substances in the extreme ultra-violet. The gion 585 A.-1850 A. was investigated. Of the sub- ances tested, platinum is the best reflector (18·6 r cent), and nickel, crystalline quartz, and gold ere the only others giving more than 10 per cent at e shortest wave-length. Chromium and silicon are oth superior for the longer wave-lengths.—**C. Y. iao**: The problem of the ionised hydrogen molecule. theoretical investigation using the polynomial ethod of wave mechanics.—**Harlow Shapley**: Note the velocities and magnitudes of external galaxies. -**Curt P. Richter** and **Miriam E. Brailey**: Water- take and its relation to the surface area of the body. ater-intake for rats increases with age and is greater r males than females. It is closely related to body rface and hence apparently to heat regulation.— **. W. Alpatov**: The influence of thyroid gland eding on the acceleration of the growth of larvæ of *rosophila melanogaster*. Larvæ given hog thyroid ere definitely larger than controls. It is suggested at invertebrates with short development period can e used as test animals for thyroid.—**G. Pincus** and **. J. Crozier**: On the geotropic response in young ts. A mathematical relationship can be shown etween the upward orientation on an inclined surface d the slope for genetically stabilised lines of young ts, and it can be traced in crosses. Thus the con- ant involved in describing homologous behaviour as a 'real' significance.—**William T. Richards** and **lfred L. Loomis**: Dielectric loss in electrolyte lutions in high frequency fields. An expression nnecting power loss, conductivity, dielectric con- ant and frequency is tested for wave-lengths from m. to 1000 m. The effect of high frequency currents organisms is correlated with the physico-chemical nstitution of their body fluids.—**Oscar Knefler ice**: The temperature co-efficient of radioactive sintegration. A consideration, based on the new uantum mechanics, of the sizes of atomic nuclei, dicates that the temperature co-efficient is very nall; hence the impossibility of influencing the lf-life period in the temperature range available.— **icholas A. Milas**: Some studies on homogeneous talysis. An expression connecting maximum oxy- n absorption rate, concentration of catalyst and me to reach maximum absorption rate has been rived and tested, using anthraquinone and benzo- uinone as catalysts for the oxidation of anethol. aximum oxygen absorption rate appears to be one the most characteristic properties of auto-oxidation enomena.—**Louis S. Kassel**: Unimolecular reactions. discussion based mainly on the new quantum echanics and criticising particularly Bourgin's ggestions.—**Henry S. Washington**: The rock suites the Pacific and the Atlantic basins. On the whole, e rocks of the Atlantic basin are more alkaline and pecially more sodic than those of the Pacific. There e other petrographic provinces, and it is considered possible that such areal differentiation could exist when the earth was in a fluid or semi-fluid condition.—**Simon Flexner** and **Cornelius P. Rhoads**: A method for the determination of the activity of antipolio- myelitic serum. The blood of human beings and monkeys recovering from poliomyelitis contains neutralising substances effective against the incitant of the disease. By injecting both virus and serum into monkeys by way of the cisterna magna (between the skull and vertebral column) no injury to nervous structures is caused, and the course of the experi- mental poliomyelitis parallels the disease in man. The results will be applied to treatment and prevention of human poliomyelitis.—**Ruth H. Lindsay**: The chromosomes of some dicœcious angiosperms. No morphological difference is recognisable between the two chromosomes of any pair in the pollen mother cells examined.—**R. L. Wilder**: Characterisations of continuous curves that are perfectly continuous.

Official Publications Received.

British.

Proceedings of the Royal Irish Academy. Vol. 38, Section B, No. 15: Semperviva of the Canary Islands Area. By Dr. R. Lloyd Praeger. Pp. 454-499 + plates 9-16. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.*

Lawes Agricultural Trust: Rothamsted Experimental Station, Harpenden. Report 1927-28 with the Supplement to the "Guide to the Experimental Plots" containing the Yield per Acre, etc. Pp. 176. (Harpenden.) 2*s.* 6*d.*

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 12: Grading and Marking of English Wheat Flour. Pp. 8. Marketing Leaflet No. 13: The Grading and Marking of Home-killed Beef. Pp. 8. (London: Ministry of Agriculture and Fisheries.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1238 (Ae. 393): The Effect of Body Interference on the Efficiency of an Airscrew. By C. N. H. Lock. (T. 2702.) Pp. 8+2 plates. 6*d.* net. No. 1239 (Ae. 394): The Application of the Theoretical Velocity Field round a Spheroid to calculate the Performance of an Air- screw near the Nose of a Streamline Body. By C. N. H. Lock. (T. 2703.) Pp. 4+2 plates. 4*d.* net. No. 1241 (Ae. 396): Experiments on a Series of Symmetrical Joukowski Sections. By A. Fage, V. M. Faulkner and W. S. Walker. (T. 2765.) Pp. 19+10 plates. 1*s.* net. No. 1242 (Ae. 397): The Force and Moment on an Oscillating Aerofoil. By H. Glauert. (T. 2763.) Pp. 17+4 plates. 9*d.* net. No. 1243 (Ae. 398): Wind Tunnel Tests on a Symmetrical Aerofoil (Göttingen 429 Section). By W. G. A. Perring. (T. 2762.) Pp. 4+4 plates. 4*d.* net. (London: H.M. Stationery Office.)

Foreign.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 1, July. Pp. ii+190+14 plates. Vol. 3, No. 2, August. Pp. ii+191-341+23 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 71: Heat and Time of Exposure necessary to kill Larvæ of the European Corn Borer in Ear Corn. By George W. Barber. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1928. Pp. 115. (Copenhague: Andr. Fred. Høst et fils.) 6.00 kr.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 9, Septembre. Pp. 467-520. (Prague: Regia Societas Scientiarum Bohemica.)

Diary of Societies.

FRIDAY, October 11.

Royal Sanitary Institute (at the Castle, Shrewsbury), at 4.30.—A. W. Ward and W. H. Butler: Some Notes on Recent Bridges over the River Severn.

Royal Society of Medicine (Clinical Section), at 5.30.

Institution of Engineering Inspection (at Royal Society of Arts), at 5.30.—E. F. Law: The Chemical Laboratory in Inspection.

Malacological Society of London (in Zoological Department, University College), at 6.—Dr. F. A. Schilder: The Eocene *Amphiperasidæ* and *Cypræidæ* of England.—G. C. Spence: The Epiphragm in *Streptaxis*.—G. C. Robson: Notes on the Dispersal of *Crepidula fornicata* (L.) in English Waters.—H. H. Bloomer: The Sex of *Anodonta cygnea*.

Oil and Colour Chemists' Association (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Cutter: Polymerisation of Drying Oils.

Manchester Association of Engineers (at Engineers' Club, Manchester), at 7.15.—J. A. Robertson: Developments in Power Production (Presidential Address).

Junior Institution of Engineers, at 7.30.—R. H. Allen: Coal and Coal Cleaning.

Leicester Textile Society (at Leicester), at 7.30.—J. W. Allinson: Colour and Design in Textile Printing.

Institute of Metals (Sheffield Local Section) (at Sheffield University), at 7.30.—F. C. Robinson: Some Notes on the Selection of Suitable Metals to Resist Corrosion (Chairman's Address).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—J. D. Pratt: Rationalisation—its Meaning and Application; with Special Reference to the Chemical Industry.
EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. O. E. Lewis, Dr. Newth, and others: Mental Deficiency.
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—E. E. Maddox: Demonstration of the Cheiroscope.—Rosa Ford: Some Ocular Complications of Nasal Sepsis.

SATURDAY, OCTOBER 12.

ROYAL SANITARY INSTITUTE (at the Castle, Shrewsbury), at 10 A.M.—W. H. Purslow: Reconditioning of Houses under the Housing (Rural Workers) Act, 1926.—Miss B. Thrupp: The Scope of a House Property Management Department.
MINING INSTITUTE OF SCOTLAND (at 79 Grassmarket, Edinburgh), at 3.—J. E. Lambert: Some Notes on Colliery Blasting Practice.—Discussion on paper by S. Mavor on Recent Progress in Underground Conveying.
BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 3.—Mary Barnett Gilson: Some Inner Conflicts in Industry.

MONDAY, OCTOBER 14.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Sir Josiah C. Stamp: Presidential Address.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (London and District Branch) (at Borough Polytechnic), at 7.—F. F. Powell: Vacuum Cleaning.
INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—Prof. W. Morgan: The Member and the Institution.
INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, Glasgow), at 7.30.—H. H. A. Greer: Chairman's Address.
MEDICAL SOCIETY OF LONDON (Annual General Meeting), at 8.—At 8.30.—D. Armour: Some of Lettsom's Contemporaries (Presidential Address).
ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—Dr. F. Albee: Original Surgical Applications of the Bone Graft.
INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—E. B. Collier, F. E. B. Moritz, and others: Discussion on Season's Malts (made from 1928 Barleys).

WEDNESDAY, OCTOBER 16.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2.—
OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—Annual General Meeting.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7.30.—B. A. Robinson: Temperature Measurement and Automatic Control.
ROYAL MICROSCOPICAL SOCIETY, 7.30 to 10.—Annual Pond Life and General Microscopical Exhibition.—At 8.—A Meeting of the Society.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.—Dr. G. Giglioli: Paratyphocus Infections in British Guiana.—Dr. W. Broughton-Alcock: Section showing Fractures Morphologically Resembling Spirochætes of a Species Common to the Mouth, lying deep within its Mucous Membrane.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—H. Sutton: Recent Development in Protective Coatings for Metals.

THURSDAY, OCTOBER 17.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Colour Group), at 7.
CHEMICAL SOCIETY, at 8.—H. Burton and Prof. C. K. Ingold: The Modes of Addition to Conjugated Unsaturated Systems. Part II. The Reduction of Conjugated Unsaturated Acids by Metals Dissolving in Aqueous Media.—Prof. G. T. Morgan and E. A. Coulson: Synthesis of Anthracene Homologues. Part I. 2:6- and 2:7-dimethylanthracenes.—A. W. Chapman: Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part I. The Triarylbenzenylamidines.—Prof. T. M. Lowry and F. L. Gilbert: Studies of Valency. Part XIV. An Optically-active Telluronium Salt: p-tolylphenylmethyltelluronium iodide. Part XV. Optically-active p-tolylphenyl-telluroxide.—Prof. G. T. Morgan and E. A. Coulson: Synthesis of Anthracene Homologues. Part II. 2:3:6-Trimethylanthracene.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Dr. G. Carmichael Low: A Retrospect of Tropical Medicine from 1894–1914 (Presidential Address).
C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Grotrian Hall, Wigmore Street), at 8.30.—Dr. Marie Stopes: Birth Control To-day Some New Methods and Experiences.
BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (in Reid-Knox Memorial Hall of the Institute), at 8.30.—Prof. H. C. Jacobaeus: Studies of Acute Massive Atelectatic Collapse of the Lung.

FRIDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Wilmot Herringham: Harveian Oration.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Trephining—Ancient and Modern.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. D. Adamson: Presidential Address.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange, Swansea), at 7.30.—Dr. A. C. Edwards: The Chemistry of Tinplate Manufacture.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Willox: Some Recent French Railway Construction.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDI (Annual General Meeting) (at Newcastle-upon-Tyne).—L. E. Smi Presidential Address.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchest —Dr. Tagliani: The Application of the Locust Beans in the Tex Industry and especially in the Calico Printing Trade.

SATURDAY, OCTOBER 19.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

PUBLIC LECTURES.

FRIDAY, OCTOBER 11.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. R. Thurnwald: The Probl of Evolution in the Social Processes. (Succeeding Lectures on O 15 and 17.)
KING'S COLLEGE, at 5.30.—Sir St. Clair Thomson: Lord List Reminiscences of a House Surgeon.

SATURDAY, OCTOBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Dav Mammoth and Man.

MONDAY, OCTOBER 14.

UNIVERSITY COLLEGE, at 5.—Dr. R. J. Brocklehurst: Secretion of Digestive Juices. (Succeeding Lectures on Oct. 21, 28, and Nov. —At 5.30.—Prof. K. Fajans: Chemical Forces and Atomic Structu (Succeeding Lectures on Oct. 16 and 18.)
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6.—Pr T. J. M. Madsen: Seasonal Variations of Epidemic Diseases.

TUESDAY, OCTOBER 15.

BEDFORD COLLEGE FOR WOMEN, at 2.—Prof. Spencer: History Chemistry.
GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeed Lectures on Oct. 16, 17, and 18.)

WEDNESDAY, OCTOBER 16.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: Health and Conditions of Work of Medical Students.
KING'S COLLEGE, at 5.30.—Prof. F. J. C. Hearnshaw: The Contribut of King's College to the Advancement of Learning during the Cent 1829–1929: History.—Dr. F. A. P. Aveling: Personalism: A Psyc logical Approach to Reality: The Experienced Self.
UNIVERSITY COLLEGE, at 5.30.—J. H. Helweg: Copenhagen, Past Present.
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6.—Pr T. J. M. Madsen: Milk Epidemics.

THURSDAY, OCTOBER 17.

KING'S COLLEGE, at 5.—Dr. J. A. Hewitt: Metabolism of the Car hydrates and Fats. (Succeeding Lectures on Oct. 24, 31, and Nov.

FRIDAY, OCTOBER 18.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.—Prof. V. Mottram: Human Nutrition. (Succeeding Lectures on Oct. 25, N 1, 8, 15, and 22.)
ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: ordinative Bio-chemistry of the Cell and Tissues: Cell Surfa (Harben Lectures) (I.).
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Glory of Gree
LONDON SCHOOL OF HYGIENE AND TROPICAL DISEASES, at 6.—Pr T. J. M. Madsen: Diphtheria Toxin and Antitoxin.

SATURDAY, OCTOBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. M. Roberts: London the Middle Ages.

CONFERENCES.

OCTOBER 10 TO 12.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS Connaught Hall, Newcastle-upon-Tyne).
Friday, Oct. 11.—Dr. W. Brand: A Scheme of National Propaga regarding Tuberculosis.
Dr. A. H. Macpherson: Combined Treatment and Technical Edu tion of Tuberculous Youths.
Dr. T. Beattie and Dr. F. Hewat: The Teaching of Tuberculosis Undergraduates.
Dr. W. H. Dickinson: The Training of Tuberculosis Medical Offic
Dr. H. Williams: Methods of Medical Propaganda regarding Tub culosis.
Dr. W. Guy: Dentistry in Relation to Tuberculosis.

OCTOBER 12 AND 13.

NATIONAL CONFERENCE FOR THE PRESERVATION OF THE COUNTRYSIDE Queen's Hotel Pavilion, Ambleside).
Saturday, Oct. 12, at 10 A.M.—G. L. Pepler, Prof. P. Abercrombie, E. James: A Policy for the Preservation of Lakeland.
At 8.—Sir Charles Trevelyan, Prof. P. Abercrombie, C. Willia Ellis, and Sir Fabian Ware: Safeguarding the Beauty of the L District as a National Heritage.
Sunday, Oct. 13, at 2.—Hugh Walpole, H. J. Massingham, and H. Peach: Special Aspects of Local Preservation.
At 8.30.—Dr. H. J. Moon: Bird Life of the District.
Dr. Vaughan Cornish: English Scenery.

NATURE

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Zimbabwe.

"IT is inconceivable", says Miss Caton-Thompson in a communication dealing with her recent investigations among the ruins of Rhodesia which we print in another part of this issue, "how a theory of Semitic origin [of the Zimbabwe] could ever have originated. Every detail in plan, building, and contents seems African Bantu." This, the latest pronouncement on a problem which has been debated for more than half a century, is an emphatic endorsement of a conclusion at which Dr. Randall-MacIver arrived twenty-four years ago. The spade once more has dealt a final blow at romantic but ill-founded speculation. Yet it is not entirely beyond understanding that an earlier generation should have seen in these massive structures the relics of an alien and advanced civilisation.

Both Miss Caton-Thompson and Dr. Randall-MacIver approached their problem as trained archæologists, without preconception, interested primarily in ascertaining the facts which each site in itself could be made to yield under strict archæological method: earlier observers had not the advantage of the training and the development in the canons of comparative study in archæology which of recent years have been made possible by the prosecution of research in widely separated areas. In fact, when the history of the discovery and the early investigation of the ruins is taken into account, a theory of their Semitic origin seems almost to have been inevitable. At the time when the attention of the learned world was directed to their existence, it was still a common experience in archæological speculation that the interpretation of data should be governed by theory rather than theory formulated by inference from the facts. Just as in Britain all prehistoric remains were once almost automatically referred to the Romans or the Phœnicians, so in Rhodesia, King Solomon, the Queen of Sheba, and the Phœnicians were almost bound to make their appearance. To these views the evidence of extensive gold-working, combined with stories of Punt, of Ophir, and of the wealth of Sofala in early Arab writers, appeared to lend support.

It was already known to the early Portuguese settlers in East Africa, and had long been known to their predecessors the Arabs, that stone-built structures—the palaces and cities of the Emperor Monomotapa, as they phrased it grandiosely—existed in what is now Rhodesia. In passing it may be noted, for what it is worth, that there is nothing in these early accounts to suggest

that the native inhabitants, the Makaranga, in making use of these stone buildings, had usurped a culture not their own. It is far from probable that the accounts of the Zimbabwe and the Makaranga in the early Portuguese writers were the result of first-hand observation. Without any doubt they came from Arab traders. Obvious errors in detail preclude personal knowledge. Later, both missionaries and Portuguese troops penetrated to the interior, and at one time the gold mines were handed over to the Portuguese under a treaty of alliance; but at the end of the seventeenth century the troops were withdrawn. *Monomotapæ Imperium* was recorded in a French map of 1705; but after that it fell into oblivion until the ruins were rediscovered in the middle of the nineteenth century.

Tales of Solomon and the Queen of Sheba and their gold attracted desultory exploration; but the first expedition of any consequence was that of Mauch, the German traveller who explored Great Zimbabwe in 1871. It, however, had already been reached by Adam Renders in 1868. Mauch's wildly speculative theories discounted the importance of his discovery, and it was not until 1890, when E. A. Maund directed attention to the problem of Great Zimbabwe in a paper read before the Royal Geographical Society, that further serious exploration was contemplated. In the following year Theodore Bent was sent out under the auspices of the Royal Geographical Society on his famous expedition of exploration among "the Ruined Cities of Mashonaland". In the course of this journey Bent explored eleven sites, while his colleague R. M. W. Swan made astronomical observations and measured the buildings at Great Zimbabwe. As a result of their observations it was concluded that the purpose of the temple at Zimbabwe was sun-worship, and that the ruins were Semitic in origin, probably dating before the Sabæo-Himyaritic period—a view for which Bent hoped to obtain confirmatory evidence in his subsequent journeys of exploration in North Africa and Arabia. He based his view mainly on the form of the 'temples', the presumed phallic significance of the conical towers, the carved soapstone birds, and the other smaller finds in which he saw a Semitic or Phœnician character.

It would be no advantage to recite here a catalogue of the numerous subsequent explorers of the Zimbabwe ruins, many of them amateurs who have destroyed evidence rather than added to our knowledge. It would be impossible, however, to pass over R. N. Hall and W. G. Neal, to whom Rhodesian archæology owes an enormous debt. They began their joint explorations in 1895. Working over a long period of years, these two explorers, at first jointly, and after Neal's death Hall alone, examined more than two hundred sites, many of them previously unknown. It was largely owing to the interest aroused by their work, and the controversy which arose out of their views, that the British Association sent out Randall-MacIver in 1905. Hall, who held strongly to the early and non-African origin of the Zimbabwe culture, hazarded the opinion that the earliest ruins might go back so far as 2000 B.C. He was able to look for support almost indifferently to any of the current theories, whether they identified Rhodesia with Ophir, or agreed with Keane, who, in opposition to the theory put forward by Karl Peters after his visit to the country in 1899, that the ruins were the work of the Ancient Egyptians, had suggested that Rhodesia was not Ophir, but Havilah, and the source of the gold of Ophir. Undeterred by Randall-MacIver's adverse conclusion, Hall continued his work after 1905 on its previous lines, now making use of his results to attack both the methods and the conclusions of his opponent. He carried with him a considerable body of opinion in South Africa. Hence it was thought worth while, when the British Association contemplated a visit to South Africa, to send out Miss Caton-Thompson—an experienced archæological explorer whose work in the Fayum had placed her in the first rank of younger archæologists—in the hope that, by clearing up doubtful points upon which question had been raised since 1905, and by once more thoroughly examining the evidence which it would be possible to obtain under the most stringent conditions of archæological method, the question of date and origin might be settled.

Miss Caton-Thompson's work calls for little comment here. In the contribution which we print she has set out clearly the position in which investigation stood as the result of Dr. Randall-MacIver's work, and the point to which she herself has carried it. It gives the essentials of her methods and results with a perspicuous clarity of exposition which can be appreciated by anyone with the merest elementary knowledge of archæological argument. The earliest possible date and the origin of the Zimbabwe culture are ascertained by excavation carried down to bed-rock. Apart from imported objects of significance for questions of date only, nothing has been revealed which cannot be referred to a Bantu culture. Typically Bantu pottery is contemporaneous with the lowest

cultural horizon. It is significant that Miss Caton-Thompson points out that in the Great Zimbabwe conical tower the workmanship by no means attains the perfection which has sometimes been attributed to it.

It is apparent from the account of the meeting of the British Association at Johannesburg at which Miss Caton-Thompson's report was presented, that the verdict was received by some of her hearers with disappointment. It may appear more credible—it may even appeal more to the imagination of some—that these ruined stone buildings, remarkably planned, with their labyrinthine passages and communicating chambers, and their impressive size, scattered literally in hundreds through an area more than six hundred miles square, should be the work of one of the great peoples who were the agents of civilisation in early days. But the interest of the problem has not vanished if our attention is turned to Africa. What were the causes which contributed to this unique efflorescence of Bantu culture? Was it wealth? According to one estimate, not less than £75,000,000 worth of gold was taken from the mines. The Makaranga became a degenerate race, broken and overrun by a virile conquering people; but the impression given by the early Portuguese records is that of a vigorous people ruled by chiefs of character and strong personality. Miss Caton-Thompson emphasises the qualities which must have come into play in building up the Zimbabwe culture. It is, in fact, but another example of the force of character and genius for administration and organisation which an African people has shown on more than one occasion, but of which the significance is usually overlooked.

Munitions of War.

Textbook of Ordnance and Gunnery. By Lieut.-Col. Earl McFarland. Pp. x + 625. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 32*s.* 6*d.* net.

THE peace-time problem of preparing for war, remote though we hope war may be, is a task which has to be attacked by the few scientific workers who are specially engaged by their governments. It is a problem which becomes more difficult as reduction in armaments becomes more drastic, and ultimately resolves itself into one of pure research. This follows three broad lines: improvement of existing material, improvement in manufacture, and improvement in method of use. The results of laboratory research are tried out on proving grounds and in arsenals; the latter are maintained as nuclei, ready for expansion, and provide munitions for the peace establishment of the nations' fighting forces.

The dissemination of knowledge so gained is effected primarily by means of text-books and generally through the naval and military scientific journals of the nations concerned. As research progresses, text-books become out-of-date and require renewal; the work under review is such a renewal, replacing the 1917 text-book on the same subject by Col. Tschappat. It is intended to provide cadets at the Military Academy (West Point), in particular, and the line officer generally, with a statement of the fundamental theory of ordnance design and a description of the more important material of the American army. It provides, in addition, an account of research undertaken during the past ten years, and an outline of the most recent manufacturing methods.

Dealing first with explosives, we are given an interesting account of post-War progress towards the production of a smokeless, flashless, and non-hygroscopic propellant. Success in this direction has been remarkable, more especially in reducing the flash. The brilliant flame of nitro-cellulose and nitro-glycerine propellants has been reduced to a dull-red glow, which is invisible at a short distance and cannot be photographed with ordinary plates or films. This result is obtained by a combination of two methods. By incorporating in the propellant relatively inert substances, which absorb heat, the temperature of the gases is reduced; this process has the disadvantage, however, of increasing the smoke. By reducing the size of the pieces of propellant the charge is consumed earlier; more work is then done by the powder gases, and they become relatively cooler. By a judicious combination of size of piece and percentage of cooling agent, the muzzle flash is eliminated without greatly increasing the volume of smoke.

The Picatinny Arsenal method of manufacturing such a propellant, which is a blend of guncotton and pyro-cotton, is given in some detail. There follows an account of high explosives used in the American services, and a brief outline of the theory of explosives; an interesting chapter on nitrogen fixation concludes with the statement that the United States should, within a few years, be independent of outside sources for its fixed nitrogen.

The treatment of the subject of internal ballistics, which deals with the motion of the projectile in the bore, is based on approximations. This we think is unfortunate, since an outline of the theory

could be given in almost the same space; it demands no more mathematical knowledge than is assumed throughout the text, and it would be more in conformity with the rest of the book. The reason given for this departure is that the formulæ obtained are simple to use; this simplicity, however, is secured at the expense of accuracy, while such essential theoretical features as mode and rate of burning, effect of size of grain and general thermodynamical considerations, are sacrificed.

The work at the Aberdeen Proving Ground includes the determination of the ballistic properties of propellants, and is chiefly concerned with the measurement of the velocity of projectiles and the pressure of powder gases.

Since 1922 an improved chronograph for measuring velocity has been in use. It consists of two solenoids, mounted at the ends of a rigid framework which can be hoisted to any convenient position. The projectile is magnetised, and is fired through the solenoids, generating an electric pulse in each; these pulses are recorded, by means of oscillographs, on a moving photographic film, against a time trace derived from a tuning-fork. The time of passage of the projectile between the solenoids is thus measured with great accuracy, and the velocity is at once obtained.

The measurement of powder pressure in a gun is much more difficult. What is required is a record of pressure against time; the pressuré rises quite rapidly to the order of 20 tons per sq. in. and thereafter subsides to about 5 tons per sq. in. as the projectile reaches the muzzle; the duration, from moment of ignition, is of the order of 0·02 second. At Aberdeen the piezo-electric pressure-gauge is being used with great success; it exploits the piezo-electric property of quartz and produces an accurate and continuous record of pressure against time.

A series of quartz discs, cut so that their geometrical and electric axes are parallel, are assembled in a hollow cylinder of bakelite. The discs are separated by thin metal plates and have alternately positive and negative faces in juxtaposition. The positive and negative plates are severally connected and the current developed (which is proportional to the applied pressure) is recorded, by means of a mirror galvanometer, on a moving film. Such a gauge will withstand and record a pressure of 22 tons per sq. in. It is calibrated in a hydraulic testing machine in which a high pressure (measured by a standard indicator) is suddenly released.

In an interesting account of a comparative test of piezo-electric and crusher gauges, it is stated that the former gives values very close to the true pressures, while crusher-gauge records are from 15 to 20 per cent lower, the discrepancy being greater for quicker-burning propellants.

A chapter on the properties, tests, and manufacture of gun-steel leads to an account of gun construction. The relative merits of built-up and wire-wound guns are discussed, and the author deduces the interesting result that a wire-wound gun cannot be made stronger than a built-up gun of the same dimensions, if the latter consists of at least four tubes.

An account is given of the new cold-working or *auto-frettage* process. The gun is generally made in one piece and the bore is subjected to hydraulic pressure rising to 45 tons per sq. in. The effect is to increase the tensile strength, more particularly of the inner fibres of the metal, the modulus varying from about 10,000 tons per sq. in. at the bore to about 12,500 tons per sq. in. at the exterior. Experiments at the Watertown Arsenal have proved that the most efficient method is to enclose the gun in a container of sufficient thickness to withstand the working pressure without permanent set. It is estimated that the cold-working process effects a saving, in time and cost of manufacture, of from 25 to 40 per cent, while, for equal weight, the gun will withstand considerably higher pressure than a built-up or wire-wound gun.

A further advance in American gun construction is the removable liner. Owing to rapid erosion of the bore, high-velocity guns have frequently to be relined, a process which necessitates returning the weapon to an arsenal. The removable liner is designed to overcome this difficulty; it enables a worn liner to be replaced by a new one by battery personnel in the field, thus effecting considerable saving in time and cost.

Breech mechanisms are treated in some detail, and an account of the theory of recoil brakes and recuperators is followed by a detailed description of American ordnance. The Waterbury hydraulic speed gear, an ingenious device for transmitting variable rotary speeds, is here described in connexion with the 16-in. gun-mounting. Field-service and coastal gunnery and instruments used therewith are dealt with at some length, but the chapter on anti-aircraft gunnery is disappointingly brief and vague.

An account of recent progress in external ballistics, including Moulton's small-arc method of computing trajectories, is followed by a description of range-tables and their use. A chapter is devoted to tanks and 'Mechanisation'; it appears that

the horse is to be retained with American divisional artillery for the present, while tractors, rather than self-propelled mountings, are to be used for medium and heavy artillery. The work concludes with a description of projectiles, fuzes, small-arms, and grenades used in the American services, and an outline of the methods of manufacturing them.

The book is a valuable contribution to the literature of military science; the diagrams are excellent, the treatment is clear and concise, and, with the exception noted, gives an adequate account of the subject.

Colloid Chemistry and Biology.

(1) *Colloid Chemistry: Theoretical and Applied.* By selected International Contributors. Collected and edited by Jerome Alexander. Vol. 2: *Biology and Medicine.* Pp. ii + 1029. (New York: The Chemical Catalog Co., Inc., 1928.) 15.50 dollars.

(2) *Elektrizität und Eiweisse, insbesondere des Zellplasmas.* Von Dr. Hans Pfeiffer. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 21.) Pp. xii + 149. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 10 gold marks.

(3) *Das Permeabilitätsproblem: seine physiologische und allgemein-pathologische Bedeutung.* Von Prof. Dr. Ernst Gellhorn. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 16.) Pp. x + 441. (Berlin: Julius Springer, 1928.) 34 gold marks.

(1) A SMALL committee of experts and a great deal of space would be required for an exhaustive review of this volume, in compiling which the editor has evidently been guided by Goethe's maxim: "Wer Vieles bringt, wird Jedem etwas bringen".

A liberal interpretation of this principle has, perhaps unavoidably, led to the inclusion of contributions which fall outside the scope of the volume: papers which have no discernible bearing on biological problems, like that on "Hydration and Viscosity of Sols", by N. R. Dhar and D. N. Chakravarti on one hand, and on the other, articles which the mere colloid chemist will read with an overwhelming sense of his ignorance, like that on "Some Physico-Chemical Aspects of Life, Mutation, and Evolution", by the editor and Calvin B. Bridges. These, however, are extreme cases, and the majority of papers show attempts to apply our present knowledge of such simple disperse systems as can be studied in the laboratory to the problems of biology and physiology.

The proteins naturally receive attention. Wo. Pauli and T. Brailsford Robertson set forth their well-known and highly divergent views in two interesting papers; to give the reader a further choice, Mr. Alexander reprints J. Loeb's Pasteur Lecture on "The Colloidal Behaviour of Proteins", as well as his own very pertinent criticisms of a thesis assuming "that gelatin is a definite chemical entity, which no one has ever demonstrated".

The reader will gain the impression that the study of pure proteins is a sufficiently laborious and difficult task, but he will realise even more vividly, after reading the group of papers on protoplasm, how exiguous a step towards an understanding of the simplest organism all this immense labour represents. "The Physical Properties of Protoplasm" (Wm. Seifriz), "Protoplasm" (L. V. Heilbrunn), "The Colloidal Structure of Protoplasm and Protoplasmic Action" (R. S. Lillie), "The Nature of the Living Cell as revealed by Micromanipulation" (R. Chambers), and "The Physical Basis of Life" (E. B. Wilson), taken together, form a compendium of the subject, the fundamental difficulty of which is summarised in one sentence by H. Handovsky in another paper: "The facts compel us to assume that the manner in which the colloids are united is an essential factor in cell function". The study of such combinations of colloids as this passage contemplates can scarcely be said to have begun.

A curious contrast with the detailed analysis in this group of papers is presented by a vast generalisation like that put forward in "The Colloidal State in Organisms", by A. Lumière, who finds the cause of physiological and pathological happenings in the ageing and the mutual coagulation of colloidal solutions.

Space does not permit more than a brief enumeration of some of the more important remaining contributions. H. Schade deals with "Colloid Chemistry and Internal Medicine", with special emphasis on the properties of connective tissue, and with "Concretions", which are, perhaps, easier to imitate *in vitro* than other products or elements of organisms. Papers by E. Zunz, F. Bottazzi, and P. Lecomte de Noüy are devoted to the surface tension of colloidal solutions, and more particularly of plasma and serum; the last-named author finds that normal and immune sera can be distinguished, even in minute concentrations, by this physical method. Contributions dealing with pathological problems as varied as the treatment of lobar

pneumonia, the entity producing chicken sarcoma, colloid chemistry and malignant tumour, etc., must necessarily make a limited appeal to specialists. So will a "Colloidobiological Study of the Vitamins", by F. V. v. Hahn, in which he arrives at the conclusion—certainly surprising to the outsider—that "the so-called vitamin-containing substances act not by means of a chemical constituent in them, but by virtue of their inherent surface activity".

The preparation of the volume has involved a good deal of translation, which, considering the stylistic difficulties and the *ad hoc* terminology of some of the originals, has been done very well. Equal care has been bestowed on proof-reading and on the preparation of the name and subject matter index. The interesting question, what class of readers can be sufficiently interested in the varied contents of the book to acquire it, need scarcely be discussed on its merits, since the price—though it cannot be called high—will, at least in Europe, probably restrict ownership to libraries and reviewers.

(2) This small volume is one of the 'Forschungsberichte' edited by Dr. R. E. Liesegang, whose general object is to present in the form of concise critical abstracts the most important advances made in various fields of science since about 1914. The somewhat puzzling title is explained by the preface, which describes the volume as an attempt "to group recent literature from the point of view how far electrophysiological relations can to-day be made to contribute towards the comprehension of vital happenings in cells". To facilitate this task, consideration has been confined to the behaviour of the proteins within and without the protoplasts, and the carrying out of the scheme leads to the grouping of a vast mass of material under three main headings: (1) Electric charges on disperse particles; (2) fundamental features of the electric behaviour of disperse protein particles; and (3) the fundamental effects of electrophysiological phenomena in plasmatic protein.

The first two sections give a concise but complete summary of the electric properties of disperse systems in general, and of proteins in particular; the 'non-electric', that is, specific effects of anions and cations, as expressed in the Hofmeister series, receive due attention. The sub-headings of the third section give some idea of its scope: the quasi-stationary state of protoplasm, the co-operation of electric charges in cell functions, and the effect of electric charges on structural elements which have undergone 'dyscolloidal' changes, that is, changes from the normal condition in the direction of peptisation or gelation. The last-mentioned portion contains numerous references to the new technique of the Prague school, some of the methods of which deserve to be known and used more extensively; for example, Fürth's cataphoresis with semi-conducting electrodes, which permits the use of fields of several hundred volts per centimetre without appreciable current.

Owing to extreme condensation the book is not easy reading, but it fulfils the primary object of a collection of abstracts: that of directing the attention of the reader to things he ought to study, while giving him a reasonable summary of what he is going to find.

(3) Prof. Gellhorn's work gives references to about 1400 widely scattered papers—all of them discussed in the text—on a problem of peculiar difficulty. It is, however, much more than a mere collection of abstracts; it is a text-book written in a thoroughly critical spirit. Nothing is more striking than the constant cautions against misinterpretation of experimental evidence or disregard of sources of error, which are certainly numerous in the investigation of permeability.

After a short introduction, the author discusses fully the various methods which have been used for determining permeability and the properties of artificial membranes, especially the dry collodion membrane, which has been the subject of recent important work. The next section deals in great detail with the permeability of plant and animal cells to electrolytes as well as to organic substances peculiar to the cell and foreign to it; with the effect of external and internal factors on these permeabilities; and, finally, with the specific permeabilities of various cells and organs and their functional differentiation.

More than a hundred pages are then devoted to the permeability of various organs; to the general reader, perhaps, the most striking mechanism is that which, in normal conditions, prevents the passage of albumins from the blood into the cerebro-spinal fluid.

The final section is entitled "Results". It begins with a summary of the evidence for the existence of "a boundary layer which regulates the permeability of protoplasm", and continues with an admirable discussion of the various theories which have been put forward for the structure of this membrane, "none of which is adequate to account for the variety of phenomena observed with widely different cells". The author sees some hope in a fusion of existing theories, which will ascribe to each single factor an importance varying with each type of cell.

The book, to which (2) is in many ways a useful supplement, should be of great interest, not only and obviously to cytologists and physiologists, but also to colloid chemists. It will provide those who are in the position—at present still uncommon—of having to look for problems with a formidable array of them ; it will also make even those who do not share Sir William Hardy's conviction ("Sixth Colloid Symposium Monograph", p. 8 (1928)) that "nothing is to be gained by claiming living matter as colloidal", realise how much remains to be done before their discipline can fully explain even the simplest properties of single cells. E. H.

Flowers of the World.

Totius orbis flora photographica arte depicta. Edited by Hugo Iltis. Vol. 2: *Floral Province of the European 'Mittelgebirge' I.* By Dr. Hugo Iltis and Bert Schulz. Translated by W. C. Worsdell. Pp. 50 + 100 plates. (Brünn: Rudolf M. Rohrer, 1928.) 29 gold marks.

THE authors have set themselves no small task in attempting to provide a pictorial presentation of the natural vegetation of the whole world. The present volume, the second in the series but the first to be published, deals with the phytogeographical region of the European *Mittelgebirge* of Engler's classification. It is stated that some further 'centuries' of photographs are contemplated of this province alone. If the intention is to deal with all regions of the world on the same scale, the work will indeed be monumental, and the cost of so many 'centuries', at twenty-eight shillings and sixpence each, will not be within the reach of many individuals.

Volume 2 consists of a brochure of fifty pages and one hundred photographic prints. The intention and scope of the work is explained, and a general account of the *Mittelgebirge* is given, followed by a more detailed account of the twenty-five 'formations' which the authors recognise as being found in this province. The brochure is published in English, French, and German. An index to the subjects of the photographs is given, and also an index to plants mentioned ; the nomenclature adopted is that of K. Fritsch's "*Exkursionsflora*". A map, in colours, gives the principal phytogeographical areas of the western part of Czechoslovakia, and the more important places mentioned in the volume.

Each photograph is separately mounted on a loose leaf which bears a caption in the three languages, giving the vegetation type and the habitat of the subject. The names of the chief plants depicted are given, and, in some cases, a brief enumeration of the principal associates. Individually, the photographs portray the plant in its immediate surroundings, and it is only by a general consideration of the series that an idea is obtained of the vegetation of the whole country.

The selection of the photographs has been made with the idea of illustrating the range of the different units of vegetation comprised in the area. The authors have considered the various general systems of classification in use, but have decided that a judicious combination of the principles generally accepted provides the best basis for the divisions which they have chosen, rather than the adoption of any one particular system. It is obvious that reconsideration will have to be given to this classification with each volume which deals with a new type of vegetation.

The work breaks new ground in presenting a study of the vegetation of a given area in the form of a series of actual photographs of plants in their natural habitat. The authors have an intimate knowledge of the area now dealt with, and, from the list of distinguished botanists mentioned as co-operating with them, it can be guaranteed that many volumes will be published which will provide an equally intensive study of "the flowers of the field" over large parts of the world. The volumes which are to deal with, for example, the little-known immense tracts of the tropics, may require different treatment, and the units of vegetation selected for each volume will require to be conceived on different scales.

In this connexion it is perhaps to be regretted that the terms 'formation' and 'association' have been introduced in the restricted application to which they are committed in the present intensive study of a part of the European flora. It is a little difficult to know what terms can now be used for the large units of vegetation which will be encountered in volumes dealing with other and less known parts of the world.

The volume is well produced, the brochure and loose leaves with the photographs being contained in a stout cardboard box neatly covered with dark green cloth and lettered in gold. The photographs have been carefully selected and admirably fulfil their purpose. The work is scarcely, from its size and cost, one that can be expected in the private library, but it will undoubtedly be of use in universities and institutions engaged in the study and teaching of botany.

Our Bookshelf.

Dynamical Systems. By Prof. George D. Birkhoff. (American Mathematical Society Colloquium Publications, Vol. 9.) Pp. viii + 295. (New York: American Mathematical Society; Cambridge: Bowes and Bowes; Berlin: Hirschwaldsche Buchhandlung, 1927.) 3 dollars.

This book comes as a welcome addition to a noteworthy series of volumes—the American Mathematical Society Colloquium Publications—and it contains, with subsequent developments, the material presented in Prof. Birkhoff's Colloquium Lectures at Chicago in 1920.

The work is entirely formal and, while one would not regard it as a book from which to approach the study of theoretical dynamics, anyone who has read, say, Whittaker's "Analytical Dynamics", will not find it difficult. In the first two chapters the author introduces the types of Lagrangian systems in an original way, and discusses some special integrals of the equations. Moreover, instead of restricting himself to equations of Hamiltonian type, he takes the general Pfaffian equations, which have the advantage of retaining their form under an arbitrary point transformation instead of only under a contact transformation.

The third chapter deals with the normalisation of the equations and their general formal solution in the neighbourhood of an equilibrium point and with the case of 'generalised equilibrium', that is, motion about a periodic motion.

Chapter iv. deals with the question of the stability of periodic motions. An interesting result (pp. 115-121) is the connexion between reversibility and complete stability. The author shows that if there is stability of the first order, then reversibility is a necessary and sufficient condition for complete stability.

The remaining five chapters follow the lines of Poincaré's geometric methods, and are concerned with establishing the existence of periodic motions in the vicinity of a periodic motion of stable type. The methods employed are certainly very elegant, though, unfortunately (except in special cases), their application seems to be limited to systems with two degrees of freedom. The last chapter deals with the celebrated 'problem of three bodies'.

The errata, though numerous, are in no case serious, and are mostly of the type which the reader cannot fail to detect and correct for himself. The treatment is rigorous, and much of it is original, and altogether the volume forms a valuable addition to the literature of the subject.

Greek Thought and the Origins of the Scientific Spirit. By Prof. Léon Robin. Translated from the new revised and corrected French edition by M. R. Dobie. (The History of Civilisation Series.) Pp. xx + 409. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1928.) 21*s.* net.

We have already had occasion to direct attention to the attempt which is being made, in this "History of Civilisation" series, to systematise, and to make more generally available, the vast amount of knowledge achieved by modern research in social studies. Prof. Robin's contribution to the series is entirely worthy of the occasion, and will probably rank as one of the finest. For immense erudition combined with perfect clarity of expression the book can have few equals. As M. Henri Berr, who writes a foreword, truly states, the treatment is marked by "discerning and cautious interpretation of doctrines", and "rigorous characterisation of systems and schools". These qualities are especially apparent in the interesting paragraphs which introduce and conclude the several chapters. Most suggestive, for example, is Prof. Robin's comparison between the immense and the living influence of Plato, in whose writings the greatest problems of thought are unravelled and prepared and established in their form for future speculation, and the more external influence of Aristotle, the form of whose writings lends itself so well to literal acceptance as an absolute authority. It was Aristotle whose influence for a long time turned science away from the paths of decisive progress. For the gift of elaboration and presentation is not the same thing as the very spirit of inquiry.

Thermochemie: Arbeitsmethoden und Analyse der thermochemischen Daten insbesondere in dem Gebiete der organischen Verbindungen. Von Prof. Dr. W. Swietoslawski. (Handbuch der allgemeinen Chemie, herausgegeben von Prof. Paul Walden und Prof. Carl Drucker, Band 7.) Pp. xi + 253. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 22 gold marks.

Prof. Swietoslawski is a well-known authority on thermochemistry and is exceptionally well qualified to deal with "experimental methods and analysis of thermochemical data with special reference to organic compounds". The present volume is the seventh of a series, of which some earlier numbers have already been reviewed in these columns (Mar. 14, 1925, p. 374; Sept. 1, 1928, p. 308). Its three principal sections deal with the methods of calorimetry and of thermochemical measurements, analysis of thermochemical data, and thermochemistry of atomic linkages respectively.

The first two sections have a somewhat specialised technical interest, but the last covers a series of problems in which all chemists are directly interested, since every organic chemist would like to know the heat of formation of various bonds of a carbon compound, and every inorganic chemist would like to know the heat of formation of the ions of an electrolyte. The information which is now available is summarised in the last thirty pages of the book, which will be read with interest by many who have no direct interest in the experimental determination of thermochemical data.

Protozoology: a Manual for Medical Men. By John Gordon Thomson and Andrew Robertson. Pp. xiii + 376 + 4 plates. (London: Baillière, Tindall and Cox, 1929.) 30*s.* net.

The preface of this book states very plainly that it is intended for medical men as distinct from research workers, and that on this account the arrangement

of the groups differs from that usually adopted by zoologists. This precludes criticism from the purely zoological point of view. The authors state concisely most of the information about parasitic protozoa essential for the medical man, but it is a pity that in a book with this definite scope the discussion of immunity and chemotherapy in trypanosomiasis should be so inadequate. A useful account of the pathology of the diseases caused by various protozoan parasites is given. The section on malaria is treated very fully and gives a good description of the conditions created by this organism. The authors have given some account of the more serious difficulties and pitfalls in the microscopic examination of blood and fæces, and there is a brief chapter on methods which will be valuable to clinicians working abroad.

The book is very fully and very well illustrated, which probably accounts for the price, which seems high for a book of this type. The bibliography is slender, but the authors excuse themselves on the score of the lists contained in contemporary treatises, such as Knowles' "Introduction to Medical Protozoology" and Wenyon's "Protozoology". There are some curious printer's errors, and the disease of 'dourine' appears in block type as 'douriee'.

Cardio-Vascular Diseases since Harvey's Discovery. The Harveian Oration delivered before the Royal College of Physicians of London on Oct. 18, 1928. By Sir Humphry Davy Rolleston. Pp. vi + 149. (Cambridge: At the University Press, 1928.) 3*s*. 6*d*. net.

This richly documented little book, written by one whose father, Prof. George Rolleston of Oxford, delivered the Harveian oration fifty-five years previously, is divided into four sections dealing with the advances since Harvey's discovery in our knowledge of cardio-vascular diseases obtained by anatomical observation, normal and morbid, unaided clinical observation, application of instruments of precision, such as the sphygmomanometer, sphygmograph, and electrocardiograph, and information derived from physiological and pathological experiments respectively. An interesting historical sketch is given of clinical methods, such as percussion and auscultation, examination of the pulse, the therapeutical use of digitalis, and such diseases as angina pectoris and exophthalmic goitre. A bibliography is appended to each section.

Histoire des fourmis. Par M. de Réaumur. Avec notes de Prof. Charles Pérez. (Encyclopédie entomologique, Vol. 11.) Pp. 116. (Paris: Paul Lechevalier, 1928.) 40 francs.

A memoir on ants which forms part of Réaumur's famous "Histoire des Insectes" exists in manuscript form in the archives of the Academy of Sciences of Paris. In 1926 an English translation of this work by Prof. W. M. Wheeler of Harvard University was published in London and New York under the title of "The Natural History of Ants". The present publication, issued by M. Paul Lechevalier, is of a somewhat different cadre, since it makes available for the first time Réaumur's observations on ants in the original French, and every effort has been made to reproduce this work in the same style as the "Histoire" to which it properly belongs. The great historical and biological interest attached to Réaumur's observations should ensure a ready welcome being accorded to this essay by entomologists throughout the world. The annotations by M. Charles Pérez and the excellent frontispiece portrait of Réaumur add materially to its interest.

Ultra-Violet Radiation and Actinotherapy. By Dr. Eleanor H. Russell and Dr. W. Kerr Russell. Third edition. Pp. 648. (Edinburgh: E. and S. Livingstone, 1928.) 21*s*. net.

The authors have maintained the previous form of their book in this, the third, edition. The work is a good one for the medical practitioner who wants information about the working conditions in ultra-violet therapy, for here he will find all the necessary details about ultra-violet lamps and their mode of action. He can also find lists of diseases for which ultra-violet radiation can be recommended.

The book concludes with a chapter on the use of these rays in diseases of the organs of special sense and in dental and veterinary practice. Even chicken runs and pig-styes are said to be run more profitably when ultra-violet radiation is supplied to their inmates. The benefit to growing animals is said to be due to an increase in the retention of calcium and phosphorus compared with that of control batches.

Faune de France. 20: *Coléoptères; Cerambycidae.* Par Prof. F. Picard. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. vii + 167. (Paris: Paul Lechevalier, 1929.) 32 francs.

Various fascicules of the "Faune de France" have been noticed from time to time in our columns. The present part, No. 20, is the first to deal with Coleoptera and provides an excellent guide to the French species of Cerambycidæ. The general introduction deals with the structure and biology of the family and includes, in addition, a most useful list of its Hymenopterous parasites. This is followed by the taxonomic part which forms the main substance of the monograph: the generic and specific key and descriptions are uniform with those of the preceding fascicules and maintain the same clarity and excellence. There is also a useful bibliography and a full index.

Modern Paper-Making. By Robert Henderson Clapperton and William Henderson. Pp. xiv + 365. (London: Ernest Benn, Ltd., 1929.) 31*s*. 6*d*. net.

In this book, "written by practical people for practical people", the raw materials, processes, and machinery used in paper-making are fully described in such a manner as to afford a clear and comprehensive account of the industry at the present day. The book is well arranged, profusely illustrated, and beautifully produced, and it should rapidly win recognition as a standard work on the subject.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Palæobotanical Evidence for the Age of the Late Palæozoic Glaciation in South Africa.

IN an article in NATURE of June 22, 1929, p. 946, Dr. H. Dighton Thomas discusses the age of the glaciation which has left its traces in the Late Palæozoic rocks of India and in various parts of the southern hemisphere. He reviews some of the considerable volume of evidence on this subject which Prof. Schuchert of Yale has so fully summarised in a recent paper (*Bull. Geol. Soc. Amer.*, vol. 39, p. 769). Prof. Schuchert concludes that the evidence is in favour of regarding the glaciation as of "Middle Permian and probably Late Middle Permian time". Prof. Schuchert here uses the term Middle Permian for the upper part of the Lower Permian of most authors.

Dr. Thomas considers that the evidence on the whole supports the view that the glaciation was in Uralian (Upper Carboniferous) times, and this is the view generally accepted by most British geologists. Dr. Thomas refers to the work of Prof. A. C. Seward and Mr. T. N. Leslie on the fossil plants found below the glacial beds in South Africa. Representatives of this flora, which has *Gangamopteris* and the closely related *Glossopteris* as its most characteristic plant genera, are also found in beds interstratified with the relics of glaciation in Australia. This flora is found in many parts of the southern hemisphere, where, as Prof. Sahni remarks, the "close relation of the Gondwana plant beds [that is, the *Gangamopteris* flora] with the glacial deposits over enormous areas" is of great significance. We are amply justified in assuming that the *Gangamopteris* flora and the glaciation were approximately contemporaneous. Of these two important plant genera, *Gangamopteris* is more characterisitic of the early (Palæozoic) phase of the flora, while *Glossopteris* has a much greater range and persists into the Mesozoic.

One of the chief difficulties up to the present has been to find points of correspondence between the *Gangamopteris* flora and the sequence of floras of the European type in which no *Glossopteris* or *Gangamopteris* occurs. These floras have a completely different floristic composition and are characteristic of the northern hemisphere, particularly of Europe, with the exception of that part of Russia in which a *Glossopteris* flora has been found.

Recently, I have had the opportunity of examining some fossil plants which Mr. B. Lightfoot found in the Upper Wankie sandstones in the Wankie district in Rhodesia. The majority of the specimens are leaves of various species of *Glossopteris* (*Gangamopteris* is not represented), but the special interest and importance of Mr. Lightfoot's collection is the presence of several species and genera of plants which have not been found associated with *Glossopteris* before but are characteristic of the European type of Upper Palæozoic flora.

The following is a list of the plants which have been identified, *G* indicating that the species is characteristic of the typical *Gangamopteris* flora, *ES* and *EL* of the European Stephanian (Upper Carboniferous) and European Lower Permian respectively, and *A* of the Upper Palæozoic of the Shansi coalfield in China: *Phyllotheca sp.* (*G*), *Sphenophyllum speciosum* (*G*), *S. Thonii* (*EL*), *S. Thonii var. minor* (*EL*, *A*), *S. oblongifolium* (*ES*, *EL*), *Chansitheca sp. cf. Kidstoni* (*A*), *Pecopteris unita* (*ES*, *EL*, *A*), *P. arborescens* (*ES*, *EL*), *P. cf. cyathea* (*ES*, *EL*), *Asterotheca sp.* (*ES*, *EL*), *Cladophlebis sp.* (*? G*), *Glossopteris indica* (*G*), *G. Browniana* (*G*), *G. Retifera* (*G*), *G. tortuosa* (*G*), *G. cf. angustifolium* (*G*), and *Cordaites Hislopi* (*G*). (An illustrated account of the flora will be published shortly in the *Bulletin of the Geological Survey of Southern Rhodesia.*)

Although in the collection the specimens of *Glossopteris* leaves preponderate numerically, it is seen in the list that the European and *Gangamopteris* types are, from the point of view of number of species, equally well represented. It has been suggested that the *Gangamopteris* flora flourished in a rather cooler climate than that of the warm or even sub-tropical type of the European province. The Wankie terrain may have had an intermediate type of climate accounting for the intermediate type of flora which is found there in the Upper Wankie sandstones.

The known vertical distribution of the northern species which form, roughly, half of the collection, shows that the flora is closely related to that of the Stephanian and Lower Permian and is therefore in all probability early Lower Permian in age. The elements of the *Gangamopteris* or *Glossopteris* flora in the collection suggest a close comparison with the Beaufort or somewhat older, Ecca series of the succession found farther to the south in Africa. Now in South Africa the glacial beds with *Gangamopteris* interbedded in them form part of the Dwyka series, which lies below and is therefore older than the Beaufort or the Ecca series, so that the glacial beds are older than early Lower Permian and must be early Lower Permian or even Upper Carboniferous themselves. The evidence furnished, therefore, by the Wankie flora is antagonistic to the view that the glaciation in South Africa is late Middle Permian, but supports the view that it is either early Lower Permian or possibly Upper Carboniferous. J. WALTON.

Botanical Department,
The University, Manchester.
Sept. 23.

THE new occurrence recorded by Dr. Walton is of great importance both for showing members of the northern and southern late Palæozoic floras in association and for indicating the age of this and other deposits. To my mind, the age assigned to the Wankie flora by Dr. Walton cannot be questioned. In one respect I should be even more definite than he. His comparison with South African floras is highly suggestive, but, on the strength of such a correlation, I should consider the Dwyka glacial beds with *Gangamopteris* to be definitely Upper Carboniferous in age. This gives independent support to the determination obtained in other ways.

The association of elements of the northern and southern floras in the Upper Wankie sandstones can but prove that the two floras were contemporaneous. Taken in conjunction with the age of the Rhodesian plant assemblage, the association gives, therefore, additional reason for believing that the *Glossopteris* flora first appeared in Upper Carboniferous times, and that the different floral facies exhibited by the northern and southern regions are to be explained by differences in geographical distribution rather than by differences in age. As Prof. Seward has said: "No Upper Carboniferous flora was in the strict sense cosmopolitan" (Presidential address to Section K of the British Association meeting in South Africa, *vide* NATURE, Sept. 21, 1929, p. 450). A certain intermingling of the northern and southern floras is to be expected in an intermediate region, such as Rhodesia appears to be. Doubtless other

mixed floras will be found in intermediate regions, and they, too, will play their part in confirming or confuting the conclusions I have drawn before—though, I believe that they, like the flora referred to by Dr. Walton, will support and not oppose those views.

H. Dighton Thomas.
Department of Geology,
British Museum (Natural History),
Cromwell Road,
London, S.W.7,
Sept. 25.

Statistics and Biological Research.

In a letter to Nature of Aug. 17, Dr. R. A. Fisher has given a clear statement of his reasons for believing that the methods set out in his "Statistical Methods for Research Workers" are adequate to deal with all problems arising in biological research as ordinarily conducted. Those statisticians who, like "Student", feel that there is need for the study of non-normal distributions particularly in connexion with small samples, might perhaps state their position as follows. In the first place, from their own experience they do not feel so confident as Dr. Fisher that the normal distribution and tests based upon it are adequate in *all* forms of biological work; in the second place, they are concerned with many non-biological problems in which forms of variation occur ranging from very slight to extreme degrees of a-normality. It is not, therefore, an academic but a very real problem for them to obtain some more exact appreciation than seems hitherto to have been reached, of the point at which a-normality of distribution renders the tests of 'normal theory' inaccurate or inefficient.

Turning to the more theoretical aspect of the problem, no one who appreciates the lines along which Dr. Fisher has developed the theory of sampling will deny that as the form of variation deviates more and more from the normal, not only may (*a*) the frequency constants or 'statistics' cease to be distributed in random samples according to the 'normal theory' law; but also (*b*), even if they are still approximately so distributed, they begin to lose their efficiency as discriminating criteria. For each form of variation there exists in theory different 'statistics' leading to the most efficient tests for the significance of differences observed on samples. The subject is one of extreme interest, but, as Dr. Fisher writes, this new realm of statistical theory is at present scarcely opened. But whether it were opened or not, I am inclined to think that a fundamental difficulty would still be present. It is this.

In practice the worker in small samples can rarely be certain from the evidence available of the exact form of variation in his population; he must, therefore, use some standard form of analysis, and if he believes from previous experience that deviations from normality if existing are unlikely to be great, he will naturally use the 'normal theory' tests. But, logically, confidence in his results is then only justified if he is certain that deviations from normality of this order will not introduce the difficulties (*a*) or (*b*) above.

As a concrete example, suppose that a biologist wishes to compare the eggs of two groups of a species of bird living in different habitats. He has collected and measured an egg from each of some ten or a dozen nests from both groups. The numbers are small, but would be of value at any rate in a preliminary inquiry. May he now compare the means and standard deviations of, say, length and breadth of eggs, for the two groups, using Dr. Fisher's t and z tests? His samples are too small to give him any information on this point, but he may turn to literature containing egg measurements on a large scale and see whether the variation in length and breadth of eggs is generally normally distributed. He would find, for example, in *Biometrika*:

Length of cuckoo's egg, 1572 cases. Frequency constants $\beta_1 = \cdot0044$, $\beta_2 = 3\cdot3483$

Breadth of common tern's egg (1914), 1592 cases. Frequency constants. . . . $\beta_1 = \cdot2618$, $\beta_2 = 3\cdot5315$

Breadth of common tern's egg (1920), 956 cases. Frequency constants. . . . $\beta_1 = \cdot1624$, $\beta_2 = 3\cdot9276$

(From *Biometrika*, iv. p. 368, xii. p. 348, xv. p. 337 respectively.)

The constants for the common tern's eggs differ significantly from the normal values of $\beta_1 = 0$, $\beta_2 = 3$. If, however, the biologist knew that for deviations from normality as great or even greater than these the t and z tests were still adequate, he would apply them with some confidence to his own data. But at present is there any published evidence which will assist him in deciding this point?

It is not questioned that in a very wide field of biological work the normal distribution is adequate. Those who work within its bounds are fortunate, but they should admit the possibility that others may meet in practice cases of distinctly non-normal variation; and therefore wish to know more precisely at what point the criteria based on means, standard deviations, and correlation coefficients fail to be distributed in sampling according to 'normal theory', and to understand a little more clearly the nature of the consequences of the inefficiency introduced by using these 'statistics'.

A-normality may arise in an infinite number of ways; it is only humanly possible to explore a few of these, but each fresh piece of information makes us more certain of the strength or weakness of our tools. By representing populations by some variable system of mathematical curves, it is possible to examine certain typical forms of deviation from the normal. But it certainly is not claimed that such an exploration would be exhaustive.

Egon S. Pearson.
University College, London, W.C.1,
Sept. 30.

West Indian Biota in New Caledonia.

When visiting New Caledonia last year, my attention was directed to the varied representation of the fauna and flora of the West Indies to be found in the island. New Caledonia is a French colony, and is visited by steamers which go round the world, calling at French ports. There has been commerce by way of the French Antilles, and some of the species accidentally brought from thence have been described as supposedly endemic members of the New Caledonia fauna.

(1) The slug *Veronicella plebeia* was described from New Caledonia by P. Fischer in 1868. It is very common in the lowlands of the island; I found it particularly abundant at Bourail. In 1925 Grimpe and Hoffmann decided that it had an extensive synonymy, and existed in localities so remote as Tahiti, Mauritius, Brazil, and the West Indies. I sent Bourail specimens to Dr. H. B. Baker of Philadelphia, and he finds them practically identical with *V. dubia* Semper of the Lesser Antilles. He remarks that all of its near relatives are neotropical. Thus it appears to have been carried from the West Indies to New Caledonia in the early days of the colony, but the earliest and valid name is that based on New Caledonia specimens.

(2) At various places, but in great abundance on

Ile Nou and near Bourail, I found a minute cylindrical snail of the genus *Gastrocopta*, which must have been introduced, as it was wholly unknown to the earlier collectors, and had not been recorded from the island. Mixed with it, but in much smaller numbers, was the well-known *G. pediculus* Shuttlw. When I visited the Bishop Museum in Honolulu, the unknown snail was readily determined (with Dr. Cooke's aid) as *G. lyonsiana* Ancey, common in the Hawaiian Islands. But Pilsbry remarks that a large proportion of the *G. lyonsiana* are quite indistinguishable from the West Indian *G. servilis* Gould, and the indications are that this also is an Antillean species, imported.

(3) More than fifty years ago the French conchologist Crosse described a small slender snail found in gardens at Noumea, New Caledonia, calling it *Geostilbia caledonica*. Pilsbry has shown that this is identical with *Cœcilioides gundlachi* Pfeiffer, a West Indian species. It still flourishes in New Caledonia, and I collected specimens. Apparently the same snail has been found in the Hawaiian Islands, but given a different name by Ancey.

(4) In 1893 I described the mealy-bug *Pseudococcus virgatus* from Jamaica. This I found in New Caledonia last year, but as it is very widely spread in tropical countries, it cannot be affirmed that it originated in the West Indies. In any case, it was surely introduced into New Caledonia.

(5) On June 11, at Noumea, I found the pretty yellow-flowered *Tribulus cistoides*, which used to be so familiar along the streets in Kingston, Jamaica. It is a West Indian weed, introduced.

(6) On the sea-coast near Bourail, under some trees, I came upon a large patch of a small but very beautiful *Salvia*, with red flowers. I thought what a lovely native plant! But on investigation it turned out to be the neotropical *Salvia coccinea*, introduced. Mixed with the normal plants were a few (which I call *Salvia coccinea* f. *pallidiflora*) having the flowers pale pinkish, with dark rosy lip. The specimens are now in the U.S. National Museum.

This list could doubtless be considerably extended, but the above will serve as good examples. While New Caledonia has thus received immigrants from other French colonies, it has been comparatively isolated from other tropical and subtropical regions. So far, it is happy in having no *Anopheles* mosquitoes, and hence no malaria. There is a serious danger that these may be imported from the New Hebrides or elsewhere, with disastrous consequences. It is practically impossible to keep malaria-infected persons out of the island, so that if *Anopheles* arrived malaria would soon be prevalent. On the other hand, the yellow fever mosquito, *Stegomyia argentea*, is present; I collected it at Bourail. But there is no yellow fever, the parasitic organism being absent. Another serious menace is the possible introduction of injurious termites from Panama or Australia. Their presence would be calamitous. There are six endemic species of termites (of the genera *Calotermes* and *Microcerotermes*), two of them only in the adjacent Loyalty Islands. These seem to be harmless, so far as we could observe, frequenting old logs along the coast.

T. D. A. Cockerell.

University of Colorado,
Boulder, Colorado, Sept. 3.

Empirical Factors in Weather Forecasting.

It is an interesting feature of the recent great advance in the art of weather forecasting that it has proceeded in independence of such small store of empirical precepts as had already been gathered in the long ages of crude observation. So far as can be made out by the layman, the official forecasts we see are direct inferences from a number of exactly recorded measurements of air pressures gathered from a very wide area. How far any unmeasurable element, such as could be called a *flair* for the behaviour of weather, comes into the transaction, we do not know. The tendency of scientific meteorology is no doubt and very rightly to discourage dependence on any such aptitude, and there is no reason to suppose that, if it exists, it is any more common among professional meteorologists than it is in the general public. We do not expect a professional psychologist to be especially tactful any more than we expect a professional mathematician to be particularly sharp in counting his change.

At the same time, it may perhaps be suggested that at the present stage of its advancement the art of weather forecasting could make use of certain unmeasurable tendencies of weather that are to be noticed by mere crude observation of its behaviour. It must, of course, be admitted that the help to be got from these sources can never be more than altogether minor and auxiliary, and such as might provide a caution or a proviso to be added to a forecast based on more trustworthy sources.

The occasion, and I hope the justification for these remarks, has chiefly been the impression one has gathered that the general tendency of the weather in a given season can, as it were, override the influence of large-scale pressure distributions and so falsify their ordinary indications. Thus, conditions of pressure which in an ordinary season would certainly bring rain are apt to fail to do so in a dry season, and so we get a repeated falsification of forecasts there seemed the usual reasons to trust. The present year has illustrated this tendency very well. It has been remarkably dry almost throughout, yet the weather has never for long been thoroughly settled in the meteorological sense. The result has been that pressure conditions have seemed repeatedly to promise rain, and on most such occasions the promise has been falsified. On many occasions the expected cloud has appeared and rain has seemed inevitable, and then in a few hours the cloud has thinned and melted away. It has appeared, in fact, as if the dry and heated land had disposed of the cloud before precipitation could occur.

The influence of the land on rainfall seems usually to be regarded as limited to the effect of high ground in causing cooling and precipitation. It would appear probable that a large tract of country dried and warmed by a long drought—as, for example, southern England during this year—can produce a marked land effect in the exactly opposite sense.

The forecasting of the 'summer' thunderstorm is another subject in which the minor factors preceptible to ordinary observation seem sometimes to outweigh the inferences of the expert. To empirical observation, three factors go to the making of a true 'summer' thunderstorm—calm, sun heat, and the season of the year. In the south of England the season during which storms are at all probable begins rather abruptly with the first week in May and continues throughout May, June, and July. From the beginning of August the liability to thunder declines and continues to do so steadily through that month. Thus conditions that in the last week of July would make severe thunderstorms almost a certainty would be unlikely to produce them in the last week of August. To the expert, on the other hand, the forecasting of thunder appears to proceed directly from the pressure conditions. If these are favourable, as, for example, when there is a failing anti-cyclone over England with a shallow depression to the south, thunder is forecast, so far as can be judged by the layman, as confidently at the end of August or even in September as in the middle of July. It is my very distinct impression, though I have no

atistical evidence for the opinion, that the trustorthiness of official thunder forecasts declines eadily throughout August.

These remarks are made with all diffidence and in ull recognition of the fact that a mere amateurish nterest in the weather is a very different thing from neteorological knowledge. I should be grateful to earn, however, whether the tendencies I have tried o point out are at all generally recognised.

Wilfred Trotter.

Harley Street,
London.

A Determination of the Dielectric Constant of the Ground.

If an electromagnetic wave spreads from a small ource situated in free space, then it is known that the mplitude of the oscillatory magnetic intensity (H) t any point is inversely proportional to the distance d) of the point from the source, provided that the istance is greater than about 1·5 wave-lengths. Jnder these conditions, therefore, the product Hd is ndependent of distance. If, however, the source is ituated on the surface of a conducting dielectric, the lectrical properties of which can be expressed in erms of a dielectric constant k, and a conductivity σ, hen Sommerfeld (*Ann. d. Physik*, (4) **28**, pp. 665-736; 909) has shown, theoretically, that the product Hd s no longer constant, but varies with the distance in manner depending on the constants k and σ.

In the case where the source is a wireless transmitter n the surface of the earth, the departure of the proluct Hd from a constant value can be determined by neasuring the magnetic intensity H at different disances from the transmitter. By comparing the esulting 'attenuation curve' with that obtained heoretically from Sommerfeld's theory, assuming arious values of σ and k, it is possible to find a heoretical curve which has the same form as the xperimental curve, and thus to fix the values of k nd σ for the ground. It has been pointed out reviously (Ratcliffe and Barnett, *Proc. Camb. Phil. Soc.*, **23**, p. 288; 1926) that measurements on long nd medium wave-lengths lead only to a value for σ, nd it is not possible to calculate k from them. Up o the present, the only measurements which have been made have been on wave-lengths so long that t has been impossible to deduce from them a value or k.

We have recently carried out measurements on a horter wave-length (30 m.) up to a distance of 1400 m. The resulting attenuation curve, in which Hd is plotted as a function of d, shows a maximum when d s about 600 m. This curve has been compared with he numerical calculations on Sommerfeld's theory vhich have recently been published by Rolf (Ingeniörs Vetenskaps Akademien. *Handlingar* Nr. 96, "Numerical discussion of Prof. Sommerfeld's attenuation ormula for radio waves". Stockholm, 1929), and its hape is found to be in agreement with the theory, if ve assume the values $k = 20$ e.s.u. and $\sigma = 2 \times 10^{-14}$ e.m.u. for the ground constants. The value for σ is n agreement with the values previously found by using longer wave-lengths. The maximum on the curve is the characteristic feature which enables a reasonably accurate estimate of k to be made. No such characteristic feature is present when longer waves are used.

J. A. Ratcliffe.
W. F. B. Shaw.

Cavendish Laboratory,
Cambridge,
Sept. 19.

Adaptation.

Notwithstanding all the discussion that has taken place since 1859 concerning evolution, adaptation, and selection, biologists are still far from agreement, not merely concerning the explanations that have been proposed, but also concerning the things to be explained. Mr. J. B. S. Haldane (Nature, Sept. 21, 1929) cites evidence that differential survival may be due to physiological differences associated with visible characters not themselves useful or harmful. Prof. D. M. S. Watson, in his presidential address to Section D of the British Association at the recent meeting in South Africa, suggested that structural adaptation may be in many cases imaginary, or may have been the cause of habit, not the consequence. He stated that in extreme cases it was not possible to doubt the special function to which a structure was adapted, but in others a similar habit occurred without any corresponding structural adaptation. As an example of this he referred to the paddle-like limbs of ichthyosaurus as proving that it was an aquatic animal, but stated that there was no indication in the post-cranial skeleton of hippopotamus that it also was aquatic: "its limbs show no swimming modification whatever".

It can scarcely be disputed, however, that the hippopotamus is not an aquatic animal in the sense in which that description may be applied to ichthyosaurus. It is a question of aquatic locomotion: we may conclude from its general resemblance to a whale, and the resemblance of its fore-limb to that of a whale or of a turtle, that the ichthyosaurus lived exclusively in water and probably in the sea, and moved only by swimming. The hippopotamus, on the other hand, spends much of its time walking on land, and when in the water swims neither continually nor rapidly. A horse occasionally enters the water and can swim, but we do not call a horse an aquatic animal.

It seems to me that the important matter is to explain the evolution of such obvious adaptations as those of the fore-limbs of whales, turtles, and ichthyosauri to exclusive aquatic locomotion, not to suggest that the modification of the limbs in these animals is not necessarily and invariably correlated with aquatic locomotion because other air-breathing vertebrates pass more or less of their time in water along the banks of rivers or lakes without similar modification of the limbs. Impartial study of the facts shows that the more constant and specialised the habit the more specialised the adaptation of the structure, while where the habits are variable the structure is more generalised and retains more of its primitive character. This applies to the limbs of air-breathing vertebrates and to vast numbers of other cases.

J. T. Cunningham.

35 Wavendon Avenue, W.4,
Sept. 27.

Melting Point of Chromium.

No accurate determination of the melting point of chromium has been published recently, so far as we are aware, and the accepted value of 1550° C. usually quoted appears to be based on measurements made in 1907–8.

Various properties of metallic chromium appeared to us to be inconsistent with such a low value, particularly the very slow rate of diffusion of chromium into iron and nickel. We have found (*J. Inst. Metals*, **40**, 273; 1928) that even in pressed bars of nickel and chromium powders heated to just below the melting point of nickel (1450° C.) very little diffusion takes place, whereas under the same conditions nickel and iron rapidly form solid solutions. An attempt was made to melt electrolytic chromium in an atmosphere

of hydrogen in an electric furnace, but at the maximum temperature of 1700° C. there was no sign of fusion. Rods of both electrolytic and thermit chromium were therefore prepared and heated by passing a current through them *in vacuo*.

A small hole drilled in the side of the rod enabled the true (black body) temperature of the axis of the rod, as well as the brightness temperature of the surface, to be determined (cf. Pirani and Alterthum, *Z. Elektrochem.*, **29**, 5 ; 1923) by means of a disappearing filament pyrometer calibrated at the melting points of tungsten, molybdenum, platinum, and iron. The difference between these two temperatures at 1600°-1700° C. was found to be 160° C. A number of determinations of surface brightness at fusion gave a value of 1760° C., giving a value of 1920° C. for the melting point of chromium. The experimental errors all tend to make this a low value. More accurate determinations will be made when larger rods of chromium are available.

C. J. SMITHELLS.
S. V. WILLIAMS.

Research Laboratories of the
General Electric Co., Ltd.,
Wembley.

March Rainfall of North-West India and Agra Upper Winds in December–January.

THE strength of upper winds in India promises to be a useful agent for long-range forecasting in this country. About 1926, Mr. J. H. Field (then Director-General of Indian Observatories) found some important relationships between Agra upper winds in September–October and subsequent winter precipitation over north-west India. Further investigations to forecast March rainfall, which I found to be very important for growth of wheat in the Punjab, revealed a correlation coefficient of − 0·82 between the departures from normal of westerly upper winds in a layer 3 km. to 7 km. over Agra during the second fortnight of December and first fortnight of January and the departures from normal of subsequent rainfall in March over the plains of north-west India. North-west India is taken to consist of the Punjab, the North-West Frontier Province, Sind, Rajputana, and Gujarat. The figures for calculated and actual departures of rainfall over this area are given in the accompanying table and are exhibited graphically in Fig. 1. The upper air data are available for 15 years.

March Rainfall over Northwest India.	Yearly departures from normal. Normal rainfall = 0·45"														
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Actual	+1·0	-0·3	0	+0·8	-0·1	+0·1	-0·4	-0·4	-0·1	-0·2	-0·4	+0·9	-0·2	-0·1	-0·4
Calculated from Agra upper winds in Dec-Jan.	+0·9	0	+0·2	+0·3	-0·1	+0·1	-0·4	-0·4	-0·2	-0·4	-0·5	+0·4	-0·1	+0·4	-0·1

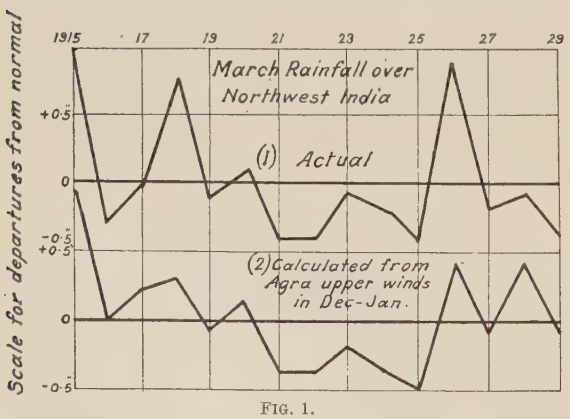

FIG. 1.

M. V. UNAKAR.

Meteorological Office,
Poona, 5,
Aug. 21.

Science and Engineering.

IN his very interesting presidential address to Section G (Engineering) of the British Association, portions of which appear in NATURE of Sept. 14, Prof. F. C. Lea attributes to J. V. Poncelet the enunciation of "the guiding principles underlying the design of vanes receiving moving fluids".

I think Prof. Lea will find that it was L. N. M. Carnot (the father of Sadi Carnot) who, in 1787, first laid down the basic rules that water engine efficiency must depend upon the fluid entering without impact and leaving without energy. General Poncelet published a memoir on water wheels in 1826, and claimed that the design of his wheel satisfied Carnot's conditions. The Poncelet wheel could scarcely be called a turbine, however. In 1827, Fourneyron constructed a machine which, in addition to being a commercially useful reaction water turbine, also went a long way towards meeting Carnot's requirements. Having regard to the date of Fourneyron's pioneering work, and the extraordinarily high efficiency of 87 per cent reached by his first turbine, one cannot help feeling that his name should at least be bracketed with that of Poncelet when tracing the beginnings of turbine development.

HUGH P. VOWLES.

20 Ridgway Place,
Wimbledon, London, S.W.19.

Band Spectra of the Oxides of Praseodymium, Neodymium, and Samarium.

BY a special arrangement of the oxyhydrogen flame, by which the dissociation of the oxides into metal and oxygen is retarded, I have been able to volatilise completely the oxides of praseodymium, neodymium, and samarium, and to photograph their emission spectra between λ8000 and λ2400.

The oxide of praseodymium shows a band spectrum extending from the extreme visible red to the violet; the most intense groups of bands are at λλ6475, 6282, 6022, 5765, 5692, 5597, 5352.

The oxide of neodymium shows groups of bands between the extreme visible red and about λ6000; the most intense group of which is at λ6580.

The oxide of samarium shows a very complicated band spectrum between λ7000 and about λ5800; the most intense group of which is at λ6506.

No bands in the ultra-violet region have been found as yet. These spectra are very likely to be attributed, at least in part, to diatomic molecules.

GIORGIO PICCARDI.

Istituto di Chimica generale
della R. Università,
Via Gino Capponi 3, Firenze (Italia),
Sept. 12.

Public Library
LAWRENCE, MASS.

The Southern Rhodesian Ruins.

Recent Archæological Investigations.

By G. Caton-Thompson.

SINCE Dr. Randall MacIver investigated in 1905 the problem of the age and origin of the Southern Rhodesian ruins, little evidence on the purely archæological side has been forthcoming, except that Mr. Douslin, then Minister of Public Works in Southern Rhodesia, partially cleared in 1915 the deep deposits in the so-called Western Temple of the Zimbabwe Acropolis. In 1924, Sir Arthur Keith reported that four ancient skeletons found in various gold-mines, and one from Zimbabwe itself, were of Bantu type, but there is no evidence that these skeletons were those of the original miners.

Dr. MacIver, both in Mashonaland and Matabeleland ruins, found at levels considerably lower than the foundation courses of the containing walls, datable Oriental and European imports of medieval age, consisting of Chinese porcelain, Persian faïence, Indian and Venetian beads, and Arab glass. These facts argued conclusively to his mind the general contemporaneity of the buildings with medieval times. With these dated imports was a quantity of native African pottery, metal work and other objects, differing little from those still made by local Bantu tribes to-day. No object datable as earlier than early medieval was found by him, or had indeed ever been found by the too active amateurs who had preceded him, who had had the pick of the untouched ground, but clung without concrete evidence to the idea of a Phœnician or even older South Arabian origin.

MacIver's argument was immensely strengthened by a structural peculiarity of the Rhodesian buildings, namely, the presence of very hard artificial floors of crushed granite (certainly contemporary with the walls), with which the builders furnished their enclosures and which, when intact, offer an absolutely impenetrable barrier against the infiltration of later objects to a lower level. In Zimbabwe's Elliptical Temple alone, MacIver put down seven test trenches through these floors to see what objects lay beneath. The results of six of these tests were as follows: In one case there was nothing; in four cases native objects identical with those found *above* the cement floor with dated medieval imports, were discovered; in one case two pieces of imported white porcelain, in company with an iron spear-head and native pottery, were found. MacIver does not specifically date these porcelain fragments, but classes them in his generalisation as medieval.

The seventh test, which was made in Enclosure 15, has become historic. Mr. R. N. Hall had, in previous years, all but cleared out this enclosure, removing 12 vertical feet of deposits from above the original cement floor, at which level he stopped. His published section shows Nankin china, Arab glass, and native pottery in what he calls his fifth stratum from the top—a stratum immediately overlying the original cement floor; from this fact he inferred its later date. Accidentally or otherwise, Hall left a small section standing. This was found and critically examined by MacIver, who asserts that Hall's stratigraphy was mistaken, and that his fifth layer, containing the medieval china and glass, was, in reality, not a separate stratum, but an integral part of the cement foundations of a hut, forming a stratigraphical unit with the cement floor on which it rested. That being so, the cement would be dated by the objects Hall found in it as medieval. MacIver carried on excavation at this spot through the cement floor down to bed-rock 5 feet or so below. He got no datable objects; but a definite stratum of ash and sand was encountered, its level being some feet below the level of the foundation courses of the Temple walls. This lowest stratum contained coiled bronze wire bangles, native pottery, and spindle whorls, similar to the same objects found associated with the medievally dated products at higher levels.

On inference, therefore, and in conjunction with his positive evidence, MacIver urges the approximate synchronism of the two within a century or two. The evidence bound up in that earliest stratum is obviously extremely important to the whole dating question, and I have concentrated our researches upon it.

At Dhlo-Dhlo, in Matabeleland, MacIver got more evidence of a corroborative nature. Beneath the unbroken cement floor of a platform in the heart of the little stronghold, he obtained Nankin china and Arab glass, lying side by side with typical African native iron and other objects. The midden and other places produced the same result.

My plan of work was as follows: First we tested the stratification over a wide, continuous area, not only down to bottom, but also with particular reference to its behaviour in relation to main walls in order to see if evidence could be collected proving the walls contemporary with a pre-medieval level. Secondly, we checked the results by means of excavations in the deepest undisturbed sections available in other areas, both at Zimbabwe and far afield in distant ruins, as well as by excavations vertically beneath some structure of unquestionable antiquity.

To fulfil the first part of this programme, a site had to be found providing two essentials not easy to come by:

(1) A site unquestionably as old as Zimbabwe's Elliptical Temple.

(2) A site showing an intact cement floor, and yet a site of sufficiently minor importance to warrant the inevitable destruction of that floor.

Dhlo-Dhlo, which I visited and tested on several

occasions, failed under the first heading; the Zimbabwe Temple and Acropolis under the second.

The Maund Ruins.

I found the spot which seemed likely to meet the case at the Maund ruins in the Valley of Ruins, Zimbabwe. The walls are ruinous, but show all the features characteristic of the Temple—the rounded, bastioned entrances, the grooved doorways, the peculiar concave or convex swing out of the bottom courses to form stepped approaches.

My test pit on virgin ground outside the Maund walls to prove the character of the natural soil showed 12 ft. 6 in. of yellow granite-sand sub-soil of Quaternary age; this was overlain by a layer of red hill-wash about 2 ft. 6 in. thick. This yellow sandy soil forms the sub-stratum of the whole of the Maund ruins, and excavations were not carried below its surface level. The Maund shows the curiously disconnected conglomeration of arcs of elliptical walls, so characteristic of the Rhodesian ruins. Some of these bound enclosures; others refuse to be connected up on any coherent plan whatever. The walls end abruptly, and our excavations, in only one case, revealed a foundation linking up two separated lengths.

Beneath a thin skin of humus we found 10 in.-1 ft. of a hard, yellow, artificial cement formed of pulverised granite. This had been laid as a floor over practically the whole area, and it covered the bottom three or four courses of the walls. This cement, in turn, overlay 2 ft. 6 in.-3 ft. of a brown-red, silty soil of natural origin—hill-wash—but containing charcoal, sherds, and iron tools and slag. Upon this the walls were actually built, and we found this to be the case, with only one exception, in every one of the twenty-nine segments of walls contained in the Maund ruins. (Substantial sections were left standing for examination by members of the British Association.) The red, silty soil passes vertically beneath the walls, which rest directly on it without any prepared foundation. In only one case does a wall rest upon the granite cement floor already described, and this wall appears structurally to be an after-thought. Above the cement floor there was a layer of humus of variable thickness, containing abundant sherds.

In the absence of any established sequence for ancient Rhodesian pottery, it is impossible to say with confidence what objects in this latter position belonged to the period of the cement flooring (the Zimbabwe period, let us call it) or what had shifted down on to it through the humus—or, inversely, what had shifted up into the humus from the surface of the ancient floor beneath. Though the cement flooring is barely covered in some places, in many others there is a large amount of red clay, locally called *dagga*, extensively introduced into these and all other ruins for hut building ('pole and *dagga*' huts). In places the *dagga* clay is piled over the granite cement floor, and in others there are clean cuts through the cement and these are filled with *dagga*. This shows that the *dagga* is later than the cement, but there is little difference in the respective contents, and probably no great length of time separates them.

Beneath the intact granite cement floor 10 in.-12 in. thick, and as hard as stone, we obtained 418 sherds of coarse, gritty, red-brown ware. The rims have a flat lip sometimes decorated with diagonal or other arrangements of shallow, square or round punches in the wet clay. Dr. MacIver figures what appears to be similar ware from the Niekirk ruins near Umtali. It is of interest to remember that he judges the Umtali-Niekirk Inyanga group of ruins to be rather older than Zimbabwe. With this class of rough pottery was a small quantity of plain black polished ware, indistinguishable from that found all through the higher levels. Iron slag and weapons were found throughout this layer, and also fragments of bangles of flat bronze wire coiled over grass fibre. These finds are just what MacIver got in his lowest ash stratum in Enclosure 15 of the Temple.

No case can be established for an occupation before the building period, and all objects excavated from a sealed deposit of this period in the Maund are typically Bantu. In the course of the work, interesting paved pathways were uncovered; these will be discussed when the detailed results of the work are published.

The Acropolis Sites.

The hill-top fortress shows evidence of many successive additions, of terraces faced by curving walls, around the original centre; it also contains the enclosure called the Western Temple. Two test-diggings revealed the middens of the early inhabitants. One of them reached granite boulders at 18 ft. Here the top 12 ft. 6 in. was *dagga* clay, artificially laid down. It yielded good iron implements and fragments of a soapstone bowl in the top 5 ft. Below the *dagga* was a black midden with ox and other bones, sherds, also two undecorated native pots, six pottery phalli and fragments of bronze wire bangles. On rock-bottom there were two more pots, apparently Bantu, and another phallus.

The other pit, which was dug through a terrace, showed a paving of thin granite slabs 15 ft.-17 ft. below the surface, surrounding a curious stone structure; the objects found in the underlying 5 ft.-6 ft. of black midden are therefore as definitely from a sealed deposit as those from the Maund. This midden, at 18 ft.-25 ft. beneath the present surface, obviously comparable with the other, yielded further types of objects such as three fragments of iron tools, iron slag, a white porcelain bead threaded on thin bronze wire, and eighty other imported beads in opaque glass. Sherds included the usual black or grey ware, but also fragments similar to those in the lowest stratum in the Maund. Here, therefore, there were inhabitants when the building of pavements such as those of the Maund came into use; whilst at some still later period, the area was levelled up to form a terrace, with high retaining wall, by

the introduction of *dagga* and rubble, completely burying thereby the earlier building. This evidence is in harmony with that obtained in 1915 by Mr. Douslin (*Proc. Rhodesia Sc. Assoc.*, June 1921–22).

The Elliptical Temple.

Trenches totalling 260 ft. in length and averaging 5 ft. 6 in. in depth have been made near the Temple, in every case reaching down to the granite rock. The results have been the same everywhere, the finds from bed-rock level being analogous to those from the midden on the Acropolis. These finds give confirmatory evidence but are not of primary value because they do not come from sealed deposits. In one place, adjoining the Mauch ruins, rock bottom is reached at 9 ft., or about 4 ft. 6 in. below the bottom course of poorly built walls. Here there are two superposed stone pavements, and here again the oldest layer, a bed of grey ash and sand 1 ft. 3 in.-1 ft. 6 in. thick, resting on bed-rock, yielded imported glass beads. As this layer passes under the walls, it may be older than they, or it may belong to the period of construction.

Around the Conical Tower have rallied the theories of foreign origins and, with the consent of the Rhodesian Government and the help of a mining engineer, a tunnel was driven under the Tower from side to side, exposing the underlying deposits down to bed-rock. The tower rests, without any prepared foundation, on 5 ft. 6 in. or so of granite-sand. This sand yielded two palæoliths. Above this came a thin layer of reddish silt similar to that in the Maund ruins ; this was sieved and washed. The objects recovered are a small iron band or clamp, a tiny gold bead, traces of a coiled bronze bangle, and a sherd of black pottery with metallic polish, similar to the ware found so abundantly in all our other excavations.

The purpose of the Tower remains obscure ; no evidence has been found to suggest it was a grave ; its workmanship is so haphazard that in a diameter of 18 ft. 4 in. there is a fall of 1·19 ft. That this is not due to later subsidence is shown by the fact that thicker courses to correct the error in the ground courses have been introduced higher up the Tower. This is scarcely the work of high civilization, and this opinion has been confirmed by numerous archæologists and engineers who visited the ruins with the British Association.

Sites in the Sabi Reserve.

This reserve, of about 9,000,000 acres, lies on the watershed of the Sabi and Inyazitza Rivers. Matindere, the best known of the ruins here, has a rare dentelle pattern in its crescentic girdle wall. We made 160 ft. of trenches, reaching granite under about 2 ft. of veldt soil and rubble artificially introduced. The finds were the usual ones, and, in the adjacent midden, more than a thousand glass and shell-disc beads were obtained, as well as nineteen others of metal, bronze, and copper.

Chiwona ruins, unknown to all but four white people, yielded rough pottery phalli, hollow perforated bones such as are known from Khami, imported beads, bronze wire bangles and spindle whorls from the midden outside the walls. The site showed signs of recent occupation. A variety in the rather stale list of finds is a fragment of black polished pottery with a frog modelled in low relief climbing up to the brim.

Mshosho ruins, with relics of massive walls and a true Zimbabwe style of entrance, yielded, both from the midden and from the bottom of a fine rock-passage, recalling that of the Zimbabwe Acropolis, more beads, establishing its age as contemporary with that of the other ruins. Mshosho also had stone foundations for grain bins on its terrace-walls and contemporary with them.

Chibrumani ruins in the Sabi-Deruli district were also examined, and yielded similar results.

Beads have been classified from sites ranging from Dhlo-Dhlo in Matabeleland to the eastern regions of Mashonaland ; these beads link up the dating evidence over this wide area.

Dating.

Two fragments of Celadon glaze were obtained from the foundations of a hut of no stratigraphical importance, and these are said by the British Museum to be of the Sung period, tenth to thirteenth century A.D., but they probably reached this remote spot later on. As to beads, Mr. Horace Beck makes a preliminary statement that some are of south Indian types, not later there than 900 A.D. Other beads are of types found in remains of villages in Malaya, and also in similar sites in Borneo, the earliest dating for which seems to lie between 600 and 1100 A.D. We thus have imports the extreme dating limits of which *in their homelands* lie between 600 and 1300 A.D. : this evidence is supplementary, therefore, to that of Dr. MacIver. I should like to take this opportunity of expressing my admiration for his sound pioneer work.

It is inconceivable to me, as it was to Dr. MacIver, how a theory of Semitic origin could ever have been started. Every detail in plan, building, and contents seems African Bantu. Further, the construction is such that, apart from repairs, not one stone would be standing on another in a period reckoned in millennia and not in centuries. My respect for, and interest in, the Rhodesian ruins is enormously strengthened by these conclusions. Instead of a degenerate offshoot of a higher Oriental civilisation, we have a vigorous native culture showing high organisation, originality, and industry. It is a subject worthy of all the research South Africa can give to it ; South African students must be bred to pursue it.

The thanks of the expedition are due to the Governments of Southern Rhodesia and of the Union of South Africa, to the Union Air Force, and to very numerous other helpers. The full results, with plans, diagrams, and other illustrations, will be published in book form.

The Millilitre.

By VERNEY STOTT, National Physical Laboratory.

THE founders of the metric system sought to establish a simple relationship between units of volume based on units of length and units of volume defined as the space occupied by a specified mass of water. To this end they decided that the kilogramme should be the mass of a quantity of water, which, at its temperature of maximum density, had a volume of one cubic decimetre. Lavoisier and Haüy made a provisional standard kilogramme and Lefèvre-Gineau and Fabbroni were entrusted with the construction of the standard afterwards known as the 'Kilogramme des Archives'. Their work was reported to the Commission des Poids et Mesures in 1799, and the 'Kilogramme des Archives' was accepted as being accurately in accordance with the original definition of the kilogramme. The litre at that time could be regarded either as a cubic decimetre or as the volume, at its temperature of maximum density, of one kilogramme of water.

During the nineteenth century, however, serious doubt arose as to whether the accepted standard kilogramme actually did comply with the original definition of the kilogramme. This was because various determinations of the mass of definite volumes of water, such as the determination in 1821 of the mass in grains of a cubic inch of water, when reduced to metric units, gave very discordant results, as shown by the following table :

MASS OF WATER HAVING A VOLUME OF ONE CUBIC DECIMETRE AT 4° C.

1821	Shuckburgh and Kater (England)	1000·475 g
1825	Svanberg, Cronstrand, Berzélius, and Akerman (Sweden)	1000·290 g
1831	Stampfer (Austria)	999·750 g
1841	Kupffer (Russia)	999·931 g

A proposal to construct a new standard kilogramme brought the whole subject under review in 1872, and the Commission Internationale du Mètre, after full consideration, then decided that the international kilogramme should be a copy of the 'Kilogramme des Archives'. The terms of the resolution were :

Considérant que la relation simple, établie par les auteurs du système métrique entre l'unité de poids et l'unité de volume, est représentée par le kilogramme actuel d'une manière suffisamment exacte pour les usages de l'industrie et du commerce et même pour la plupart des besoins ordinaires de la science ;

Considérant que les sciences exactes n'ont pas le même besoin d'une relation numériquement simple, mais seulement d'une détermination aussi parfaite que possible de cette relation ;

Considérant enfin les difficultés que ferait naître un changement de l'unité actuelle de poids métrique ;

Il est décidé que le kilogramme international sera déduit du kilogramme des Archives dans son état actuel.[1]

Thus the original definition of the kilogramme was deliberately abandoned, and the kilogramme is now simply the mass of the plain cylinder of platinum-iridium alloy known as the International Prototype Kilogramme.

As a result of this decision, the litre could no longer be regarded as equal to both the cubic decimetre and the volume at its temperature of maximum density of one kilogramme of water. The litre, however, was not precisely defined until 1901, when the definition at present accepted was formulated as follows :

L'unité de volume, pour les déterminations de haute précision, est le volume occupé par la masse de 1 kilogramme d'eau pure à son maximum de densité et sous la pression atmosphérique normale ; ce volume est dénommé litre.[2]

As a consequence of this definition of the litre and the earlier abandonment of the original definition of the kilogramme, there is now no direct theoretical relationship between the definitions of the litre and of the cubic decimetre. The relation between the two units rests entirely upon experimental determination. As a result of extensive series of experiments carried out with great care at the Bureau International des Poids et Mesures, Sèvres,[3] and a recent small correction introduced by Ch.-Éd. Guillaume,[4] the value accepted at present for the relation between the two units is

$$1 \text{ litre} = 1000{\cdot}028 \text{ cm}^3.$$

Any uncertainty in this equivalent may be regarded as confined at most to one or two units in the last decimal place. Remembering that Lefèvre-Gineau and Fabbroni made the 'Kilogramme des Archives' in the eighteenth century, the smallness of the difference between the litre and the cubic decimetre shows that their work must have been carried out with great care and skill.

It is perhaps unfortunate, but, in view of the great experimental difficulties, scarcely surprising, that the International Prototype Kilogramme does not exactly fulfil the intentions of the founders of the metric system. As a result, there now exist two distinct metric units of volume—the cubic decimetre and the litre—which are nearly equal in magnitude, and confusion has arisen through due regard not always being taken of the distinction between the two units. For most practical purposes the difference is so small as to be negligible, but where high accuracy is necessary it cannot be ignored.

The two units correspond in type to the cubic foot and to the gallon respectively in the British system, and both types of units have their uses. For example, where quantities involving volume occur in mathematical calculations, or when volumes are determined directly from linear measurements, the cube of the unit of length is normally the appropriate unit of volume ; many determinations of capacity or volume are, however, most conveniently made by methods involving the weighing of quantities of water or other liquids and the second type of unit is then the more appropriate.

In scientific work involving the use of volumetric glassware, a further source of confusion has been introduced into the question. About the middle of the nineteenth century, at a time when, as we have already seen, the mass of a cubic decimetre of water was not at all accurately known, Mohr [5] suggested, in effect, that the space occupied at 17·5° C. by a quantity of water having an apparent weight in air of one gramme should be taken as the unit of volume for the purpose of calibrating volumetric glassware. His system, therefore, did not involve any knowledge of the weight of a cubic centimetre of water, which was a distinct advantage when accurate data for this was not available, but quite inexcusably he called his unit a cubic centimetre. The system was widely adopted, and the practice still exists to-day of regarding, say a "1000 c.c." flask, as being correct, if, at its own standard temperature, it contains a quantity of water having an apparent weight in air of one kilogramme, this being a stage less definite than Mohr, who did retain a definite standard temperature. Actually such a flask, if its standard temperature were 15° C., would contain 1001·98 cm³. Further, apparatus made on this basis and marked "c.c." exists side by side with apparatus similarly marked "c.c.", but correctly calibrated in terms of the cubic centimetre. Thus of two flasks each marked "1000 c.c.", one might contain 1000 cm³ and the other 1001·98 cm³.

The Joint Committee for the Standardisation of Scientific Glassware found that one of its first tasks was to consider this position, and in 1924 it unanimously recommended :

> That the recognised international metric units—the 'litre' (l) and 'millilitre' or thousandth part of the litre (ml)—shall be used as the standard units of volume, and that standard volumetric glassware shall be graduated in terms of these units and marked 'ml' instead of 'c.c.'.[6]

In the edition of the pamphlet, "Tests on Volumetric Glassware", issued in 1924, the National Physical Laboratory also strongly recommended the use of the millilitre for volumetric glassware.

British manufacturers quickly acted on these recommendations, and for some years past practically the whole of the volumetric glassware submitted to the National Physical Laboratory for test has been marked 'ml' by the manufacturers and calibrated in terms of the millilitre.

A parallel development, also recommended by the Joint Committee for the Standardisation of Scientific Glassware, is the increasing use of the millilitre and the abbreviation 'ml' in publications dealing with methods of analysis. For example, whilst 'c.c.' was used in the first edition of "Standard Methods of Testing Petroleum and Its Products", published in 1924, 'ml' was exclusively used in the second edition published in 1929. The millilitre is also being used in Government publications, for example throughout the section on methods of analysis in Statutory Rules and Orders, No. 421—The Fertilisers and Feeding Stuffs Regulations, 1928. It is also used in papers on analysis in the American official publication, *Bureau of Standards Journal of Research*; incidentally, the Bureau of Standards recommended the use of the millilitre for volumetric glassware in 1916.

Another direction in which the millilitre is being employed in preference to the cubic centimetre is in the use of g/ml as a unit of density instead of g/cm³. In the "International Critical Tables", for example, g/ml is extensively employed. This is a logical development from the fact that ultimately practically all determinations of density involve the density of water, which from the definition of the litre is unity at its temperature of maximum density (approximately 4° C.) when expressed in g/ml. It follows that specific gravities $S_{t/4^\circ C.}$ are identical with densities in g/ml at the temperature t. Sometimes, however, specific gravities $S_{t/4^\circ C.}$ are quoted as densities in "grammes per c.c.", even though the number of significant figures given is such as not to warrant the difference between the millilitre and the cubic centimetre being thus ignored.

In general, the millilitre is the most appropriate unit to use whenever the particular determination is such that the millilitre is directly involved in virtue of the weighing of quantities of liquid entering, directly or indirectly, into the determination.

It would probably avoid a considerable amount of very undesirable uncertainty and confusion if the correct internationally approved abbreviations ml and cm³ were systematically employed to represent the respective units and the abbreviation 'c.c.' entirely discarded.

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[3] *Trav. et Mém.*, vol. 14, 1910.

[4] "La Création du Bureau International des Poids et Mesures et son Œuvre", Ch.-Éd. Guillaume, Paris, 1927, p. 258.

[5] "Über die Aichung der Liter-Flaschen." Fr. Mohr., *Z. anal. Chem.*, 7, 258; 1868.

[6] "Units of Volume", Report No. 1, Joint Committee for the Standardisation of Scientific Glassware, 1924.

Obituary.

Prof. W. H. Perkin, Jun., F.R.S.

THE death of William Henry Perkin, junior, on Sept. 17, is both a tragedy and a catastrophe in chemistry. The loss is irreparable : men of his type are not being made to-day ; they cannot be under the prevailing system. He is taken from us, not after he had accomplished his task, but in the fullness of his working powers, as ardent as ever in his enthusiasm for the laboratory bench as the *fons et origo* of all chemical discovery. There have been disturbing signs of late years that he was losing some of his physical vigour. At the time of the Pedler lecture, in May last, he admitted that he felt ill but no organic lesion was discovered and his death has not been assigned to any definite cause. The beginning was severe stomach derangement.

Perkin's career was straightforward and uneventful. Born on June 17, 1860, not with a silver spoon in his mouth but one of horn or bone, full of colour, only four years after his father's discovery (when eighteen years old) of the *first* aniline dyestuff, *Mauve*, he grew up in the healthy atmosphere of rural Sudbury, at first going to school locally, then, at the age of fourteen, to the City of London School, passing at seventeen to the Royal College of Science, whence after two years he went to German universities, first to Wislicenus at Würtzburg, then to Baeyer at Munich. He was five years abroad. On his return he spent a year in the Owens College, Manchester. In 1886 he went to Edinburgh as first professor of chemistry at the newly founded Heriot-Watt College, of which (Sir) F. A. Ogilvie was Principal. Hudson Beare was his engineering colleague. Here Kipping was his assistant—until he became mine. I recollect going north to steal him, because of the reputation the two had already made for themselves. In 1892 Perkin passed from Edinburgh to Manchester, to succeed the great Schorlemmer and become the colleague of H. B. Dixon. In 1912 he was appointed to the chemistry chair at Oxford, in succession to Odling. Odling had quietly collected Dürers and given delightful breakfasts: Perkin at once began to make chemistry hum and, at the same time, played the piano and tilled the soil, with his own hands, with a skill and vigour and bonhomie unimagined up to that time to be possible in the river-valley atmosphere of grassy, wordy, Oxford. Having had relations in Oxford, with whom I often stayed as a youth, I have known the town at least since 1860; I have, therefore, always been specially interested in the University. At the time of Odling's appointment, we—young chemists of the day—foresaw and knew what must be the fate of our subject during his reign.

Excepting the fine work of the Harcourt school, Oxford was chemically dead when Perkin went there: now it is alive—even exploding; alive too in the other sciences; rather eaten up with mathematical vanity, perhaps, yet well upon the upgrade, with many of its early failings corrected (see NATURE, June 16, 1904; June 30, 1921). The chief danger lies in its neglect of the arts. Whereas, formerly, it was all for words, to-day it is unduly neglecting them and fostering the fell disease of the age—specialisation. It is strange that *Universitas* should now spell narrowness. The pendulum of reform will always swing too far. The unholy competition which prevails in the schools, the false motives which guide study, are common to all schools: the starkly staring vice of an age of highly competitive commerce, unrelieved by any higher æsthetic sense. The spirit in which the Perkins have worked is all but dead—the cry of art for art's sake, of science for the sake of science, is seldom heard: instead, bold advertisement extends even unto the most distant stars; the Nobel prize, medals and honours invite. An Epstein ugliness is allowed everywhere. The Epsteins would even restore us to phallic worship, it seems: at least, the railway magnate is actively aiding them to do so. Perkin senior would have loathed to pass through St. James's to-day; his sympathy would be entirely with St. Giles.

As soon as the young Perkin could toddle, to be with his father he will perforce have followed him into his laboratory: to be duly taught how to blow himself up without harm, then left to develop: we know he learnt much at home. There is no record of distinction at school. Perkin jun. took to chemistry as a duckling takes to the water: it was in his blood, it was in his bones. He became one of the most accomplished and productive workers the world has known: like his father before him, he did his work—all the critical part of it—himself. His students were more often than not just his body slaves—employed in preparing endless amounts of difficult raw material, for he had princely ways of working with large quantities: yet could do with microscopic amounts. No Lamarckian influences were the cause of his character: no manganese he ate ever made him black (it's pretty certain it hasn't any moth): he was the purest possible product of an hereditary transmission of genius; his younger brother, A. G., is all but his twin as a chemist, also gifted with 'fingers' of surpassing delicacy.

To understand the sons it is necessary to have known the father. When their characters have been grasped, he and his two sons will stand out as a veritable trinity—one nature in three bodies: necessarily with variations but alike at core, intellectually and morally. It is a matter of interest, that a third son, by a second wife, who also took to chemistry and became a consultant, was purely commercial in his outlook and had none of the holy fire in him which almost consumed his father and step-brothers. I am one of the very few who knew the father intimately but many are left who have known the sons: if we are ever to understand the psychology of the chemist, it behoves us all, without delay, to write down all that we know of the triad, giving such analyses as each of us can—leaving the several accounts to be collated and woven into a memoir by competent sympathetic hands. I already have one invaluable notice, from one of the first to work under him in Manchester. Whoever may write "Father and Sons" will have an opportunity of framing an epic of modern discovery of surpassing interest.

W. H. Perkin the first was a phenomenon. At fourteen he took his own photograph; he also applied to Faraday for a ticket of admission to the Royal Institution and attended his lectures. Less than ten years afterwards, Faraday returned the compliment by being present at the lecture Perkin gave at the Chemical Society (May 1861) on "Colouring Matters derived from Coal Tar". He made his discovery of mauve (1856) when a lad of eighteen: it is true, while a student under Hofmann—but as a private venture, in his laboratory, at home. The primary discovery meant little, it was an accident; the separation of the dyestuff by one so young and untrained was a great feat; a still greater was the persistence he showed in getting it tested as a dyestuff in practice; greatest of all was

the marvellous skill and enterprise he displayed in undertaking its manufacture for dyers' use. The founder of the organic chemical industry, now a colossal enterprise, he was a full-blown manufacturer at nineteen : so magnetic was his enthusiasm, that his father (a builder) was inspired to put most of his capital into the son's new venture, his brother to become his helper, especially on the business side. Almost everything had to be done for the first time —materials got together, appliances designed, processes invented, every detail worked out.

Perkin sen., in fact, was possessed not merely with scientific interests but with an astounding technical *flair*. A few years later, when Graebe and Liebermann made the colouring matter of madder root, *alizarin*, artificially, Perkin joined in the chase and was the first in the field with a practical process, that upon which the most remarkable and intricate industry of modern times has been largely built up. It is noteworthy that Faraday was the first to use the sulphonation method which Perkin adapted to the manufacture of alizarin. Still later, by the discovery of a method of producing coumarin —the odoriferous principle of the Tonka bean— Perkin was to lay the foundation stone of the artificial perfume industry, though by this time he was too tired of the works to develop his discovery ; he also contributed not a little to the artificial production of indigo, the importance of which, of course, he could not foresee.

Nevertheless, successful to a moderate degree as he was as a manufacturer, he was so possessed by the demon of scientific inquiry, that Perkin sen. gave up his business in the early 'seventies and turned his attention once more exclusively to his laboratory. I learnt to know him at this period and became his fellow secretary at the Chemical Society. Great as he was as a manufacturer on the technical side, he lacked the commercial spirit. I have never known a more upright, less worldly man. Herein lies the explanation of the son. The holy spirit of inquiry, which burnt so steadily in the father, flared up in the son, at an early age—probably the fire was greatly fanned by Baeyer. In praise and pursuit of what he always spoke of as Research, Perkin jun. was as mad as several *Mad Hatters*. His joy over each beautiful new substance was extreme— he gloried in constructing. This gave him his power but limited his sense of proportion and his influence. He had no patience with those who did not engage in research : in fact, he thought little of them as chemists. In his laboratory, he was master of a supreme technique. Yet he never displayed the technical *flair* shown by his father. I believe the work he did for the chemical industry, during and after the War, was of no particular moment—he had not really seized its problems and made little contribution to its development, except in details. Of all our chemists, he has been the most human, the most inspiring, in his absolute adoration of the laboratory and its ineffable art— an art fully disclosed only to the few—an art insufficiently encouraged and practised to-day : yet the art upon which alone industry and progress are founded. Hypotheses may be built up in the air and stated upon paper : they can only be tested and developed in the laboratory. Our schools have yet to give proper training in the use of the laboratory—to put it upon a scientific and real footing.

Perkin jun. has set Oxford a great example and a great task : that of organising the teaching of chemistry *as a whole science* and making it effective as such, as the necessary helpmate of all the experimental sciences and as underlying life. Oxford and Cambridge are national universities, not technical schools ; it should be their office to provide general scientific instruction for all—not to rear narrow specialists. They receive between them by far the most important share of the intellectual ability of the country. It behoves them to return this in the highest state of efficiency. Unfortunately, the method which prevailed in the past, especially in literary subjects—coaching in association with competitive examination—has been extended into natural science studies. The result is an artificial system of education which is not calculated to fit the recipients for really efficient service in the world. The coached mind never gains a proper freedom. The work the system entails upon teachers—work that is highly remunerative and therefore popular —can have but one result : that of sterilising the teachers' practical activities as original inquirers. Men coming from universities where coaching does not prevail, on the average, are better trained for public service than are those coming from our two ancient universities. The public schools suffer greatly under the system : having been coached themselves, the teachers they draw from Oxford and Cambridge naturally coach rather than train the young minds they direct. The whole country suffers as a consequence. The funds and administration of the two universities have been made the subject of public inquiry and regulation : far more important would it be to examine into their ethics and raise these in standard. An appointment in chemistry at Oxford to-day is no local affair but a matter of national concern—such is the present and coming supreme importance of the science.

The act by which Perkin jun. made himself most noteworthy in the University of Oxford was in securing the provision of a fourth year, to be spent in learning the methods of research, as necessary for the honours degree. It is a grave question whether this be a wise provision. It involves the assumption, that the years previous to the fourth are not years in which the spirit of inquiry is inculcated and rampant. They should be—yet, if they were, it would not be necessary to set aside the fourth year for the purpose. To begin in the fourth is too late. There are many students who never can become original workers : at least some of these may be trained to be very effective teachers. Men of the Perkin spirit may well have exaggerated the value of the quality which is their inherited and almost divine prerogative.

Perkin jun. has painted a wonderful gallery of chemical portraits—among them several masterpieces : in the polymethylene series, in the terpene series, last but not least in that most fascinating of all—the great group of natural alkaloids. To

discuss these is now impossible: of their permanent great value there can be no doubt. He painted many studies in preparation for larger compositions; he scarcely ever descended to pot-boilers. Probably, he is most deserving of study as a great master of method: the certainty of his touch was most remarkable; the range and extent of his knowledge of past achievement was astounding. Yet he formed no school at Oxford. The fine laboratories he built were largely used for elementary instruction in organic chemistry but men did not go to him from the colleges: those who worked under and with him mostly came from outside. He was no prophet in his own house. The college system must be made to give way to one of unselfish co-operation, if training in chemistry, as a complete science, ever be given in Oxford. The mistake Perkin jun. made in going there was not to make this a condition of his entry—he was strong enough to exact such bargain. The change had already been made in Cambridge. The man appointed to be his successor should be strong enough to carry out this necessary, most vital reform.

Although Perkin's fame among chemists was even greater than that of his father and the value of his work was fully recognised here, it was not everywhere properly rated abroad; the list of his honours is not long. Especially have we to complain that he was never awarded the Nobel prize. His work may be equated with that of anyone who has secured this: very few of the chemists to whom it has been given have done work of the same importance to our science. His work was not merely that of a pioneer and highly original in design and execution: he pulled many plums out of the chemical pie, succeeding not once but often in solving grand problems. Still, there was nothing of the sensational about his work and his modesty ever prevented him from advertising. In this respect he was a simpler man even than his father. The Swedish assessors seem to have no eye for an English chemist—thus, in the past, they have overlooked men such as Crookes and Dewar. "Most injustice is not inflicted deliberately but because people do not take the trouble to think things out. Thinking gives them headaches and, if persisted in, may cause them to change their opinions. So it simply isn't done" (Rudyard Kipling). I have heard it said, that this was because these were not nominated by their countrymen: the excuse will not apply to Perkin jun. If the rules for the race involve this, the sooner they are altered the better: it should rest with the assessors to take all necessary steps to make the award in a scientific spirit, not contingent upon chance nomination. Colleagues, if not countrymen, are too often jealous of each other and inclined to work in companies. Overdue also is an inquiry of the effect of the prize upon our scientific *morale*—whether it have not introduced a wrong spirit into the art of experimental inquiry and whether the money could not be used to better purpose.

Perkin jun. was also overlooked by his father's Livery Company, the Leathersellers. He should long ago have been made an honorary freeman. His father's picture hangs in their Great Hall. The gown he wears is proof that he was appreciated, at least by Scottish learning: the St. Andrews scarlet is made dominant through him in the City of London. I have often said that some day the picture will be the most valuable possession of the Guild. When Master, Perkin grimly sought to make water prevail at their festive board and would have filled the Loving Cup with mere soda-water; perhaps this made the name less thought of than it should have been.

Perkin jun. had a very happy life. He was ever full of *joie de vivre*. He was happy in his achievement, happy in his home. He married in 1887. Kipping, in the course of his studies, had discovered beauty among his cousins in the Quantocks and took the chief with him, in the long vacation, to Bridgwater, to stay with his uncle, W. T. Holland. Perkin at once fell to the eldest daughter; Kipping, a little later, married the second. Afterwards, when Kipping was my chief assistant at the Central Technical College, Kensington, and Lapworth a student with me, visiting Kipping, Lapworth was captured by the youngest sister. Three distinguished chemists thus became intimately linked through their wives. It is a distressing fact that these unions were not all fruitful: only Kipping had children. The two Perkin brothers have no issue, so that the male line comes to an end with them. There would seem to be some influence at work promoting sterility in scientific workers. The problem is one needing close attention, especially by the advanced woman; no birth control seems called for, rather the opposite. Perkin was a man of great physical as well as spiritual energy. Whatever he did was done with an astounding intensity and concentration of purpose—he never spared himself. In Manchester, he played cricket and also tennis with great vigour. Then, when the pace became a little too rapid, he took to gardening and became an expert in the glass-house cultivation of auriculas, carnations and chrysanthemums; he has always been noted as a successful grower of carnations. At Oxford, he gloried in roses and the herbaceous border.

To limn father and sons fully will be to tell a wonderful story of effort and achievement. Such differences as there have been between them are rather of time than of temperament. The father was an early Victorian, with a highly developed vein of narrow Victorian piety—an evangelical, almost a puritan—accentuated probably by his wife's rigidity of outlook. Sons brought up in such an atmosphere naturally tended to go off at a tangent—yet never viciously. It has been told of one brother, that he added to his pocket money by playing the flute in a music hall orchestra: the parents would have thought him to be in the grip of the devil had they known this. The sons have belonged to our modern period, though scarcely to the 'skirt above knee' stage: a display of ankle to the beauty line was sufficient for W. H. jun., who was always the simple æsthete. W. H. sen. was a good judge of wine in his early days and his brother was always the bon-vivant; later he became total

abstainer and vegetarian, probably to his injury. W. H. jun. loved good living and kept a good cellar —college port appealed to him when of the right age. He was eminently hospitable, especially to musicians—entertaining if possible, everyone of musical distinction who happened to come to Manchester or to Oxford, greatly enjoying the opportunity that this gave him of indulging his love for chamber music and playing piano in trios and quartettes. The father played both the piano and the violin—the sons have been little short of professionals, the younger being master of almost every wind instrument.

Sweet were the uses he made of heredity—with it seeing good in many things. His loss is to be bitterly deplored in our science and in our society.

Henry E. Armstrong.

Mrs. H. R. Mill.

Frances Mill, who died Sept. 10, was the daughter of Dr. F. R. MacDonald, and was born at Inverary, Argyll, where for a time she attended the Parish School. The effects of its democratic atmosphere were perhaps discernible in the adaptability and wide sympathies which made her later an accomplished hostess, and enabled her to find points of contact with all sorts and conditions of people. She displayed early a great interest in geography and the kindred sciences, and a visit of about a year's duration to Australia, prior to her marriage to Dr. H. R. Mill in 1889, stimulated this interest, and helped to prepare her for her prolonged collaboration with him in his geographical and meteorological work. She proved a quick and careful proof-reader, prepared the indexes to most of her husband's books, and acquired great skill in the painting of lantern slides for use in connexion with his lectures.

Mrs. Mill assisted in the bathymetrical survey of the English Lakes, carried out by Dr. Mill and Mr. Heawood, in which her quickness, accuracy, and skilful steering of the boat proved of great value. Her powers of observation and keen perception of the unusual are commemorated in the name of the rare Central African monkey *Cercopithecus Francesca*. The skin of this monkey was sent to her with some other furs by a missionary friend, and though it was twice rejected by the authorities of the Natural History Museum as coming from a region too well known to yield anything new, her persistence led finally to an admission that it belonged to a previously undescribed species.

Over a long period of years Mrs. Mill attended regularly the annual meetings of the British Association, and took part in the Canadian meeting of 1897 and the South African one of 1905. She accompanied her husband also in all his travels, visiting every Dominion of the British Empire, in all the continents and over all the oceans. She was a familiar figure at the meetings and social gatherings of the Royal Geographical Society, and enjoyed the friendship of all the great travellers and explorers of the last forty years. In London, at Mill Hill, and after 1914 at Dormans Park, Surrey, her hospitable instincts found free play within a large and varied circle; for wide as her scientific interests were, they by no means exhausted the range of her activities.

News and Views.

At the quarterly meeting of the Council of the Royal College of Surgeons of England on Oct. 10, Lord Moynihan, president of the College, announced the foundation of a research scholarship in surgery by Lord Melchett. There is great need for such scholarships, as at present candidates for the staffs of our great hospitals have often to spend their time in coaching and offices of drudgery to gain a livelihood while waiting for a vacancy. The Melchett Scholarship, which is worth £500 a year and promised for a period of seven years, will permit a young surgeon to devote his time to research in one of the basal subjects of surgery—particularly experimental surgery. The Council of the College of Surgeons, by accepting Lord Melchett's gift and by founding another scholarship of like value from its own funds, has taken a step to supply a need which has long been felt in medical London. The laboratory accommodation in connexion with the museum of the college is being extended, and it is proposed that the scholars should be associated with the museum in their researches. The president of the college is also hopeful that a farm for experimental research in surgery and pathology will be established near London and in direct connexion with the museum.

At intervals reports have found their way into the Press from Germany of some experiments conducted by a pyrotechnic specialist on the discharge of a rocket to very great heights. From a report in the *Times* of October 11 it appears that the Ministry of Communications has given permission to discharge a rocket which is designed to reach a height of some fifty miles in about one minute. There are no recording instruments to be carried; the height will be determined trigonometrically, although some difficulty should be experienced in following an object moving at a mile per second at such close range. The rocket apparently is 30 ft. long and 18 in. in diameter and consists of a double tube of metal which will be filled with liquid oxygen. By some mechanism not explained, four carbon rods immersed in it will be burned and the discharge of the generated gases will provide the propulsive force. The head of the rocket is fitted with revolving steering fins and the tail with stabilising fins. The nose contains a parachute which it is hoped will unfold when the motive power is exhausted and bring the rocket gently back to earth. The rocket will weigh 143 lb. when loaded. From the information published, it is scarcely likely that the optimistic hopes of the inventor will be

realised, but an experiment of this nature is well worth watching, as it may possibly provide a means, if controllable, of investigating the conditions in the upper atmosphere. The inventor, according to the newspaper reports, envisages a rocket post between Europe and America which would make the journey in about thirty minutes, but this may be regarded as optimism with news value. Although there is a tendency to consider the venture and its extravagant claims with a humorous tolerance, the results of the experiment will be awaited with some considerable interest in scientific circles.

AMONG the many attractions of the South African meeting of the British Association one of the most highly appreciated was the opportunity of examining the large number of copies of Bushman rock-drawings and paintings which had been brought together for the visitors' inspection. Especially valuable were those made by Miss Wilman, particularly as many of the engravings recorded by her have now disappeared. At Johannesburg, the collection made by the Frobenius expedition, which occupied three rooms, attracted much attention. The significance of this field of investigation in relation to South African prehistory has yet to be made clear. An opinion, for example, is gaining ground that the drawings may not be the work of the Bushmen but possibly of some other race such as the Korannas. Much more research on the age and sequence of the paintings has to be done before anything like a positive pronouncement can be made. Their resemblance to the palæolithic art of the north has of course often been pointed out; but detailed examination on strictly scientific comparative lines is still to be desired. An indication of the nature of future research was afforded by the communication from the Abbé Breuil which was presented to the Anthropological Section at Cape Town. In discussing the palæolithic art of Spain he pointed out one marked point of similarity between that school of art and Bushman art in the more diagrammatic treatment of the human body as compared with the realism of the animal figures. In this connexion we may mention that Miss Jean Marshall of Rothesay, a member of the Association, in a letter to us, states that while at the Victoria Falls she was much struck by the similarity in action and pose of the distorted shadow of a Kaffir walking in the sunlight to the Bushman figures, and suggests this as a possible origin of their style. The Abbé Breuil gave it as his view that the similarity or indeed identity of the Libyan rock-drawings and the Bushman figures might justify us in regarding Bushman art as a prolongation of the palæolithic art of Spain.

IN continuance of its scheme of development and settlement, the Commonwealth of Australia Government has authorised the construction of the Wyangala Dam on the Lachlan river. The dam will lie about six miles below the confluence of the Abercrombie with the Lachlan where the latter flows in a deep valley. The catchment area above the dam is 3000 square miles. It is estimated that the supply of water will be sufficient to irrigate about 1,357,000 acres along the Lachlan and other streams. Provision will also be made for the generation of hydro-electric power at the dam. In conjunction with a fuel burning plant, the dam will supply power for a distance of 100 miles.

THE Publications Committee appointed some time ago by the Commonwealth Government to administer a small fund for the publication of scientific memoirs of high merit, the printing of which was beyond the resources of local scientific societies and not attractive to commercial publishing houses, has made arrangements for the issue of two works. The first of these is by Dr. Edward Kidson, formerly of the Meteorological Bureau of Australia but now holding a similar office in New Zealand, dealing with the meteorological observations of the first Shackleton (*Nimrod*) Expedition. The observations are some twenty years old and their publication should be of distinct value in connexion with present-day scientific activities in the Antarctic. The second work is by Mr. W. D. Francis, Assistant Government Botanist in Queensland, on the rain-forest trees of Australia, with copious illustrations.

SIR ARTHUR KEITH discusses the antiquity and evolutionary position of 'Peking man' (*Sinanthropus Pekinensis*) in the *Lancet* for Sept. 28 on the evidence of the fragments of skull and the teeth discovered near Peking in 1927 and 1928 and recently described by Prof. Davidson Black of the Peking Medical College. The material available for determining the position of early man in China now consists of a fossil tooth, which formed part of a Chinese apothecary's stock-in-trade, described by Prof. Max Schlosser in 1903; two human fossil teeth identified among fossil material from the cave at Choua Kou Tien near Peking by Dr. Zdansky when working at Upsala in 1926; the unworn crown of a child's lower molar tooth found in the cave in 1927; and (1) several large fragments of the cranial wall; (2) almost the whole of the right body of a lower jaw; (3) the greater part of the lower jaw, including the chin region of a child of seven or eight years; and (4) about 24 isolated teeth. These were discovered by the expedition to the cave in 1928. The fossil animal remains from the site fix the age at early pleistocene.

IT appears from Sir Arthur Keith's inquiry that *Sinanthropus* takes a place with *Pithecanthropus*, Piltdown man, Heidelberg man, and Rhodesian man, but in a sense is more important than any, as it reveals affinities to modern man more than they do and has a better claim to take a place on the line of descent culminating in modern man. The fragments of the cranial wall reveal a brain as large as that of the lower living races; in their dimensions and arrangement the teeth are not materially different from those of the Australian aboriginal. The canine teeth are not apelike as in Piltdown man; yet simian features are to be seen in details of the cusps and crowns of the molars. Changes are, however, to be observed identical with those in the teeth of neanthropic man. The bony framework of the lower jaw reveals stages in the passage from anthropoid to human form. The simian shelf is disappearing and

the true chin is appearing. One feature, however, causes hesitation as to the place of *Sinanthropus* on the evolutionary line—the large size of the pulp cavities of the molars; like the teeth of Neanderthal man, the teeth of *Sinanthropus* exhibit taurodontism. If for this reason he were not to be given a place in the direct line of descent of modern man, *Sinanthropus* stands at the base of the pleistocene root of modern man and very nearly in the line of direct neanthropic descent.

DR. C. V. DRYSDALE, superintendent of the Admiralty Research Laboratory, has been appointed director of the Scientific Research and Experiments Department of the Admiralty, in succession to Dr. F. E. Smith, who was recently appointed secretary to the Department of Scientific and Industrial Research.

As in the case of other subjects, the literature of the preservation and transport of food is now considerable and scattered in a variety of journals, so that it is difficult for workers in different parts of the world to keep abreast of the latest researches. The practical importance of the subject, now that preserved foods form so large a part of the dietary in many parts of the Empire, led the Imperial Agricultural Research Conference in 1927 to recommend that the Low Temperature Research Station at Cambridge should issue from time to time lists of elaborated titles of useful publications. The first of these texts has now been published and covers the period up to January 1929 (Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv + 85. London: H.M. Stationery Office, 1929. 2*s*. net); it is proposed to issue them bi-annually. In a brief historical introduction, the author refers to the more important work carried out before 1927 on the engineering and biological problems of the science of cold storage of food including its transport. In the lists of useful publications, each title is followed by a brief note indicating the salient features of the paper. The different foods are dealt with separately under the headings of meat, pig flesh, poultry and game, fish, eggs, dairy produce, fats and oils, fruit and vegetables, grain, crops and seeds, theory of canning and of freezing and chilling, bacteriology, engineering, and miscellaneous. Each section is subdivided into the following subsections: influence of ante-mortem conditions on storage properties, cold storage, chemical antiseptics, canning, by-products, spoilage and putrefaction, methods of analysis, biochemistry and miscellaneous.

SIR PHILIP DAWSON gives an interesting discussion in the *Electrical Times* for Oct. 10, of the present position and the future prospects of electricity supply in Great Britain. He attributes the fall in the coal consumption per head of population of the industrial nations to the rapidly increasing use of electricity and the more efficient use that is being made of fuel. In Great Britain the coal consumed per capita in 1925 was 9·5 per cent lower than in 1913. In the United States it was 13·7 per cent lower, and in Germany, even including the coal supplied for reparations, it was 17 per cent lower. Still greater reductions were made in Switzerland and Sweden, partly due, doubtless, to the increasing use of hydro-electric power. In Italy the use of hydro-electric power saves nine million tons of coal per annum. We are struck by the large use made of electricity by the German chemical works. The synthetic ammonia industry consumed in 1927 more than 1000 million kilowatt hours. The cyanide industry consumed an equal amount, and the carbide industry 550 million kilowatt hours. This alone equals half the amount sold by public supply companies in Great Britain during 1927. In Germany the total amount of electricity used in 1927 for farming was 750 million kilowatt hours. Of this amount only about eight per cent was used for lighting. Ninety-five per cent of the parishes in Germany are supplied with electricity. Sir Philip thinks that the Electricity Act of 1926 will greatly benefit Great Britain as a whole. In his opinion, the question of distribution differs entirely from that of generation and transmission. It should be left in the hands of those who know local conditions and have their interests at heart. Wherever there is the largest amount of electricity consumed per capita the industrial progress is greatest.

SIR ALDO CASTELLANI has written a valuable survey of the influence of climate, apart from parasitic causes and hygienic conditions, upon the health of Europeans living in the tropics, with a useful bibliography ("Climate and Acclimatisation", *Jour. Trop. Med. and Hyg.*, July 1 and 15). He maintains that although parasites and imperfect sanitation cause the largest proportion of illness and death in the tropics, climate itself has a deleterious influence, being debilitating, diminishing the resistance against disease, probably decreasing fertility and affecting the nervous system. Useful suggestions are given; for example, the painting of buildings a dark red colour, never white or blue, a rose colour for the walls of rooms, the planting of trees for shade along roads, which should be red as white roads are exceedingly trying, and the employment of adequate protection against the sun for the head and spine.

SIR JOHN BLAND-SUTTON, Bt. (Past President of the Royal College of Surgeons), presided at the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on Monday, Oct. 14. The Council renewed the grant to The Cancer Hospital (Free) for the special scheme of radiological research which is being carried out upon the effects of X-rays upon the blood constituents and bone marrow. This work is a comprehensive scheme of research approved of by the Campaign three years ago and is carried out jointly by research workers and clinical workers, with the object of correlating the findings of experimental work with those observed in the treatment of patients suffering from cancer. A further grant of £250 for one year was also made to Mr. E. Nevill Willmer for the continuation of his research work on the relation of the chemical nature of the media in which cultures grow to the growth of the cultures. A report from the finance committee

showed that grants made by the Campaign during the last year for research purposes amounted to approximately £25,000, whilst donations received during that period only amounted to approximately £17,000.

IN *Chemistry and Industry* for Sept. 13, Prof. H. E. Armstrong contributes a very interesting article on the work of Kekulé, who was born in 1829, and is perhaps best remembered for his famous hexagon formula for benzene. Prof. Armstrong has some interesting things to say about the contemporaries of Kekulé, particularly Gerhardt, Williamson, and Kolbe. He points out that, although Kekulé's benzene hypothesis and symbol came just at the right time, when the period of intensive study of the derivatives of benzene was beginning, yet Kekulé himself made little use of them. Molecular formulæ were not then in systematic use. One of the most important researches on the subject, which had a profound influence on the benzene theory, was Körner's, published in 1874 in the *Gazetta chimica italiana*, on the relative positions of the radicals in the substitution products of benzene. Prof. Armstrong's article throws light on a number of places in the history of chemistry in the mid-nineteenth century.

A COURSE of public lectures on "Early Man and his Culture" has been arranged for the coming session by the Council of the Royal Anthropological Institute. On Nov. 1 Prof. G. Elliot Smith will lecture on "The Evolution of Man"; on Nov. 13 Sir Arthur Keith on "Race Building, Past and Present"; and on Dec. 11 Prof. F. G. Parsons on "The Anthropological History of the Modern Englishman". The second half of the session will be opened by Mr. M. C. Burkitt, who will lecture on "Most Primitive Art" on Jan. 15. He will be followed by Mr. Harold Peake, who will lecture on the "Origin of Agriculture", and by Prof. J. L. Myres, who will deal with "The Early Use of Metals". The lectures will be given at 5.30 P.M. on each day in the Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic, Little Titchfield Street, Oxford Street, W. Admission will be free.

THE Annual Report of the Leicester Museum and Art Gallery records the commencement of a three-story extension, designed for the housing of collections illustrating the knitting industry and the history of boots and shoes and for the preservation of ancient documents. But already the Committee announces that still further building will be necessary for the more adequate presentation of works of art, for objects illustrating British history, and for collections of the natural and industrial resources of the city and county of Leicester. It is estimated that the cost will be at least £13,000. Of this, £5000 has already been promised, and the Committee appeals for donations towards the remainder of the amount.

IT is now generally recognised that the value of the collections in a museum is vastly enhanced by a catalogue which is something more than a mere list of exhibits. This principle is especially applicable to an ethnographical collection, and is well exemplified in the new edition of the handbook to the collection of weapons of savage, barbaric, and civilised peoples in the Horniman Museum at Forest Hill, London, S.E., which has recently been issued by the London County Council under the title "War and the Chase" (London: P. S. King and Son, Ltd., 1929. 6*d*.). Since the first edition of the handbook was issued some years ago, the collections have been very considerably extended, necessitating the new edition, which, like the first edition, has been prepared by Dr. H. S. Harrison, the Curator. It does not aim at cataloguing the exhibits *seriatim*, but rather at demonstrating the principles of development, following the main outlines of arrangement, which if not strictly in evolutionary series, does, as the author says in his preface, throw light upon the broad lines of advance in the evolution of weapons and in many cases of individual types.

IN view of the character and purpose of the Horniman Museum, it must be admitted that both the method of arrangement of exhibits and the scope and method of the handbook itself are calculated to be of more service in stimulating interest among the public than the geographical arrangement, which may appeal more directly to the student of specific cultures, but is more appropriate to the larger and more complete collections of a national museum. Apart from its value in connexion with the collections of the Horniman Museum, Dr. Harrison's admirably written handbook might well serve as an introductory textbook to this special branch of anthropology, especially as it takes a very sane view of the highly controversial question of 'independent invention'.

JUST as books of travel are interesting to people who neither have travelled nor intend to travel, so also illustrated and descriptive catalogues of scientific apparatus and fittings have a fascination which is not limited by the length of the year's budget. Messrs. A. Gallenkamp and Co., Ltd., of 17-29 Sun Street, Finsbury Square, London, E.C.2, have recently published a revised catalogue (List *F*) of laboratory fittings, including 'Technico' standard unit type benches, from which the fittings for assembling a complete laboratory can be selected. There are obvious advantages in being able to order, say, a cupboard and two-drawer unit, a bottle-shelf unit, a sink unit, a one-drawer table unit, and a fume-cupboard to fill wall space which is immediately available, with the knowledge that as extension becomes desirable similar and other standard units may be built into the scheme in a very simple and adaptable manner. It is, however, necessary to take into consideration factors other than space when a laboratory is being planned, and a number of details and suggestions which will be found useful in this connexion are set out in the catalogue. The list includes portable and fixed vacuum pumps, steel laboratory furniture, and the Willett petrol air-gas system.

THE "Guide to Current Official Statistics" (London: H.M. Stationery Office; 1*s*. net) makes its seventh annual appearance. This compact volume of some

three hundred pages provides a detailed index of subjects with references to the official publications in Great Britain in which the relevant statistics are to be found. There is also a list, arranged under the heading of departments, of the various publications of the year with full indications of the content of each. The volume should be of great value to workers in many subjects and makes accessible many important statistics that might easily be overlooked.

Applications are invited for the following appointments, on or before the dates mentioned :—A research student at St. Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (Oct. 22). A temporary full-time teacher of organic chemistry at the West Ham Municipal College—The Principal, West Ham Municipal College, West Ham (Oct. 25). An instrument maker at the Bradford Technical College—The Principal, Technical College, Bradford (Oct. 25). A junior physicist at the Cancer Hospital (Free) for work in connexion with the radiological research scheme of the British Empire Cancer Campaign—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (Oct. 30). A research assistant in the Seed-testing and Plant Diseases Division of the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (Oct. 31). An assistant chemist in the Government Laboratory, Baghdad—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Nov. 7). Keepers, respectively, of Vertebrate Zoology and Botany at the Public Museums of the City of Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool (Nov. 14). A junior entomologist under the Division of Economic Entomology of the Council for Scientific and Industrial Research of the Commonwealth of Australia—F. L. McDougall, Australia House, Strand, W.C.2 (Nov. 18). A director of the Australian Commonwealth Solar Observatory, Mount Stromlo, Federal Capital Territory—The High Commissioner for Australia, Australia House, Strand, W.C.2 (Nov. 21). A director of the research institute of the Animal Diseases Research Association of Scotland—The Secretary of the Association, Moredun Institute, Gilmerton, Edinburgh (Nov. 23). A professor of economics in the University of Tasmania—The Agent General for Tasmania, Australia House, Strand, W.C.2 (Dec. 1). A resident pathologist at the Perth, Western Australia, Hospital—The Secretary, Perth Hospital, Western Australia (Dec. 10). An assistant lecturer in zoology in the University of Sheffield—The Registrar, The University, Sheffield. An assistant scientific officer for a Rubber Experimental Station—"Rubber", c/o W. Abbott, Ltd., 32 Eastcheap, E.C.3. A principal of the Rotherham Technical College—The Secretary for Education, Education Offices, Rotherham. A laboratory steward in the Bedford School Science Laboratories—C. W. Hansel, Bedford School, Bedford. An assistant in the physiological department of the Research Station at Trinidad of the Empire Cotton Growing Corporation—The Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S.W.1. Research assistants under the British Cotton Industry Research Association, one with special knowledge of the colloid state and some training in mathematical physics, and one to work on the action of light on cotton—The Director of Research, Shirley Institute, Didsbury, Manchester.

Our Astronomical Column.

Recent Sunspots.—The decline of solar activity noted in Nature of July 13, p. 69, has been apparent during the last few months. A few rather large spots have, however, been seen—two of them recently—and the details of these are given below.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
7	July 9–17	July 10·7	6° S.	1200
8	July 11–23	July 17·1	15° S.	500
9	Sept. 29–Oct. 11	Oct. 4·7	11° N.	700
10	Oct. 6–17	Oct. 10·8	19° S.	900
11	Oct. 7–19	Oct. 13·4	10° S.	750

(Areas in millionths of sun's hemisphere.)

Group No. 7 was one of rapid growth. A magnetic disturbance, with range in horizontal force of 260γ, was registered at Abinger on July 10. No. 8 was a spot possessing an abnormally large magnetic field. On Aug. 13·0, the spot, much diminished, crossed the central meridian again, and a small magnetic storm commenced at Abinger on Aug. 14 at 16^h; an aurora was seen the same night from Sidmouth. No. 9 was a stream growing from a few spots seen first at the east limb. No. 10 was an active stream developing from two tiny spots on Oct. 6. No. 11, a single spot, easily visible to the naked eye. A magnetic disturbance commenced on Oct. 7 and lasted until Oct. 10.

Comet Schwassmann-Wachmann.—It is suggested in *Jour. Ast. Soc. Pacific* for August that comet Schwassmann-Wachmann (2), discovered last January, may be identical with minor planet 525, Adelaide, discovered by Wolf in 1904, but not seen since that year; the following are the elements of the two objects :

	Comet.	Adelaide.
T	1929 Mar. 23·655	
ω	357° 57′ 6″·6	281°·490
Ω	126 7 14·4	126 ·093
i	3 43 16·8	3 ·250
ϕ	23 22 39·0	21 ·778
log a	0·5386785	0·52372
log q	0·3191540	0·32236
	Period (years) 6·42714	6·10344

It will be seen that Ω, i, and q agree closely, ϕ and the period are fairly near; but ω (and therefore the direction of the major axis) differs by nearly a right angle; it seems very improbable that so large a change could have occurred in the direction of the major axis, while that of the node remained unchanged. A further argument against identity may be drawn from the fact that Palisa observed Adelaide several times in 1904 with the large Vienna refractor; he made no note of anything abnormal in its appearance, which he would probably have done if it had been a comet.

Research Items.

New Social Survey of London.—It is now more than forty years since Mr. Charles Booth began his great social survey of London, which occupied seventeen years and was published in a number of volumes. It is of importance to assess the social changes that have taken place in the intervening period and to extend the scope of the work. A new social survey has now been started by the London School of Economics. Some account of the scope, methods, and aims of the work are given in a paper by Sir H. Llewellyn-Smith in the *Journal of the Royal Statistical Society*, vol. 92, pt. 2. The area to be included does not correspond accurately with any administrative area, for these have little relation to present urban growths. North of the Thames it has to be pushed beyond the county of London. As a whole it includes, on the basis of the 1921 census, a population of $5\frac{1}{2}$ millions, of which $4\frac{1}{2}$ millions were then within the county. The methods of the important survey of poverty differ from those used by Booth inasmuch as intensive methods on the lines of Prof. Bowley's 'sampling' will be combined with the older extensive system of indirect information from schools, police, and clergy. Other branches of the survey will deal with industries, especially clothing, boot, shoe, and furniture trades, to which Booth gave special attention; crime; occupations; wealth and the use of leisure. Considerable progress has already been made with the poverty survey.

Birds of a Prehistoric Kitchen Midden in California.—The levelling of the Emeryville shell-mound on San Francisco Bay, in connexion with building operations, gave an opportunity for a detailed study of its contents (*Univ. Calif. Pub. Zoo.*, vol. 32, 1929, p. 301). The mound was the kitchen-midden of a prehistoric Indian settlement, and its remaining portion measured 150 ft. and 250 ft. in diameter and 22 ft. in height. A very considerable age is indicated by the size of this accumulation of food refuse, as well as by the fact that the lowest level of the mound was 2 ft. below high tide mark, and although the age cannot be definitely determined, it may be roughly 1000 or more years old. The bird remains were represented by 6700 specimens, of which 4155 were identifiable. Fifty species of birds were recognised, although no discrimination was made in the species of ducks or of gulls. Forty-five of the identified species occur to-day in the San Francisco Bay region, which contains in addition twenty species not represented in the mound. Four species are now absent from the region, though there are records of their presence in historic times, and only one species (*Grus mexicana*) has not hitherto been found in the area. The bones of summer and winter birds show that the habitation of the site continued all the year round, bones of nestling cormorants that an island rookery was raided; the general ensemble suggests that the Indians restricted their hunting to their immediate vicinity, and broken bones indicate either cookery methods or some attempt at making artefacts.

Measures against White Fly.—A novel scheme for combating the greenhouse pest, white fly, is being carried out by the Cheshunt Research Station, Herts, under the auspices of the Empire Marketing Board and the Ministry of Agriculture. It consists of the introduction into the infected house of a chalcid wasp (*Encarsia formosa*), which lays its eggs within the young stages of the fly known as 'scales'. The mature wasp is a very minute insect, the female being pale yellow and the male dark in colour. It is entirely harmless to plants. Tomato shoots, bearing scales already parasitised, will be forwarded *free of charge* to any grower experiencing trouble with white fly, on application to the entomologist at the Station. The size of the house is immaterial, but the number of houses and the type of plant infected should be stated. The shoots are tied into bunches and hung up for three weeks, preferably in the shade. If the average temperature is about 70° F., black scales, showing by their colour that they have been parasitised, may be expected after fourteen to twenty-one days on the under side of the infected foliage. At low temperatures the wasp does not lay its eggs so readily on many plants and the percentage of parasitism is accordingly smaller. The most suitable time for starting the parasite is from late March to early June, and unless the greenhouse is kept heated and well stocked with plants throughout the winter, it is not advisable to apply for parasites after the end of July. Should the infestation be very severe, immediate fumigation may be necessary. For this purpose $\frac{1}{8}$ oz. sodium cyanide dropped into a jar containing $\frac{1}{2}$ fluid oz. of 33 per cent sulphuric acid per 1000 cubic feet is recommended, since it kills the flies, but is harmless to the scales and the parasites within them.

Cutaneous Sense Organs in Fishes.—Mr. Denzaburo Miyadi, in a paper entitled "Notes on the Skin and Cutaneous Sense Organs of some Cobitoid and Gasterostoid Fishes, with Special Reference to the Rudimentary Nature of the Lateral Canal System" (*Memoirs of the College of Science*, Kyoto Imperial University, Series B, vol. 4, No. 2, article 4, 1929), describes his observations on *Misgurnus anguillicaudatus*, *Cobitis buvœ* and other Cobitoid fishes; also on the stickleback *Pungitius Kaibarœ*. In all these fishes he finds that the canal system is rudimentary or absent and probably degenerate, being represented in the *Misgurnus* species and in *Cobitis buvœ* by a short canal or vestiges of a canal on the anterior portion of the trunk only, as is the case in the European stickleback described by Plate. It is a general rule in the development of the lateral canal that the head precedes the trunk both ontogenetically and phylogenetically and, as the author found that in the Japanese stickleback the canal in the head is formed very early when the fish is only 1·5-2 cm. in length, whilst that of the trunk appears only after it has grown to 2·5 cm. or more, he regards it as highly probable that the case of the European stickleback is due to a degenerative process similar to that in the Cobitidæ, and suggests that "In both families Cobitidæ and Gasterosteidæ, when the degeneration of the canal system takes place, it is in the anterior portion of the trunk that this process occurs last of all".

Snakes and Termites—a New Example of Symbiosis.—Certain snakes have been found to occur in the nests of termites; even great pythons as well as a species of *Typhlops* occasionally inhabit the mounds of *Termes bellicosus* on the Gold Coast and elsewhere. Lizards have gone even further, and several South American species are known to deposit their eggs in or on termitaries suspended in trees. Up to the present, the egg-laying habit has not been observed in termitophile snakes, and Dr. F. Kopstein's discovery, during an expedition to West Java, adds a notable item of information (*Treubia*, June 1929, p. 467). From a nest of the termite, *Lacessititermes sordidus*, found on

a tree 3 metres from the ground, he saw a small newly hatched snake issue, and in the course of the evening four were found to leave the nest. The snake belonged to a rare species, *Dipsadomorphus jaspideus*, and its newly hatched young had probably never been seen before, but the most interesting point was the association with the termitary. An examination showed that in the centre of the nest, which measured 20 cm. in diameter, were six egg-membranes which still contained fresh white-of-egg. Each egg lay in a cell of its own, encased in a capsule of the material used in the building of the nest. The outer layers of the nest showed no trace of an opening through which a snake of the size of the adult could have entered to deposit the eggs, and the author is of opinion that the eggs were laid in the nest at an early stage of its growth, the termites continuing to build their structure around them. The advantages to the snake are obvious: a high temperature, high and constant humidity for the development of the eggs, and for the young snakes abundant food if they chose to live upon termites, which is not at all certain.

Chinese Reptiles.—An account of the reptiles of the mountainous province of Fukien and neighbouring areas has enabled Clifford H. Pope to state many facts and conclusions of wide interest (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, Sept. 1929, p. 335). The collection of 2749 reptiles yielded 6 forms of turtles, 19 of lizards, and 71 of snakes—a remarkably rich fauna for so limited an area. It contains three elements: widely distributed reptiles found throughout great tracts of south-eastern Asia, forms common in Central China, and tropical and semi-tropical forms found on the coastal plains. The general aspect is that of the fauna of China, except for the absence of the desert forms of Mongolia, and a close relationship is evident with the Formosan fauna. Examination of the stomach contents showed that snakes had decided food preferences. Of the aquatic forms some preferred frogs, others added fish to their diet, but closely related species might show distinct differences, *Enhydris chinensis*, for example, being a fish eater, while *E. plumbea* was content with frogs. Amongst the land forms birds, rats, and other mammals, and even snakes, were common diets; but while earthworms formed a natural food supply for burrowing and nocturnal species, such as *Tapinophis* and *Trirhinopholis*, it was less easy to understand why a large diurnal snake like *Liopeltis major* should select the same fare. It is noted that with age a general fading of the most contrasted elements of the colour pattern may take place, and this may produce so different an emphasis upon the different elements in the pattern as to suggest that young and old belong to distinct species.

Fauna of Streams.—Few contributions have been made in Britain to the study of the ecology of streams, so that the work of E. Percival and H. Whitehead is specially welcome (*Jour. Ecology*, Aug. 1929, p. 282). They have classified the stream-bed faunas, which they have investigated in the West Riding of Yorkshire, into seven categories according to the nature of the bottom, and this is connected with the general succession of conditions in passing down a stream, and therefore with the speed of flow of the stream itself. Detailed analyses are given of the main constituents of the fauna, for it was discovered that the bulk of the population was made up of a few types of organisms which varied with the environment. Accordingly, the variations have been correlated with the conditions as they affected the density of the population. The chief controlling factor in clean runs of water was the rate of flow, the slackening of the current coinciding with an increase in the number of genera. A very interesting table shows the ecological relationship of the organisms to each other and to the fundamental foods. From this it is evident that conditions favouring the growth of unicellular and filamentous algæ, that is, a stable substratum, aid in the development of a considerable insect fauna, and the reason is that, judging by food contents, 75-90 per cent of the organisms feed mainly upon algæ. Many of the organisms thought to be almost the sole source of food of fish, such as *Limnæa peregra*, *Gammarus pulex*, and *Ephemera* spp., have been found to contribute, in many places, either no part or very little part of the total fauna.

Mexican Earthquake Sea-Waves of June 16, 1928.—During the afternoon of June 16, 1928, a strong earthquake occurred off the coast of Mexico. The epicentre was in the Acapulco Deep, about 125 miles south of the Mexican state of Oaxaca. Though the origin was so distant, the coast towns in this region suffered considerable damage. The sea-waves that swept over the shores and added to the destruction were recorded at Hilo (*Hawaiian Volcano Observatory Monthly Bulletin* for June 1928). The first waves reached that station on June 17, 8 hr. 29 min. after the occurrence of the earthquake, the maximum range of the movement being about 16 inches, and the period at first about 22 minutes, or approximately the same as the period of the natural water oscillation of Hilo Bay. The distance of the origin from Hilo being 3860 miles, it follows that the mean velocity of the sea-waves was 455 miles per hour, a figure that agrees closely with the values obtained for other sea-waves across the Pacific, namely, 453 miles per hour for the Japanese earthquake of 1896 and 465 miles per hour for the Valparaiso earthquake of 1906.

Earth-Tilting by Tidal Loading.—A valuable contribution to our knowledge of the tilting of the earth's crust caused by tidal loading has lately been made by Mr. R. Takahasi (*Earthq. Res. Inst. Bull.*, vol. 6, pp. 85-108, and vol. 7, pp. 95-101; 1929). Two of Prof. Ishimoto's tiltmeters, constructed entirely of silica, were placed on a concrete platform on the floor of a cave cut in Mesozoic rock at Misaki near the southern end of the Miura peninsula, Sagami Bay. The cave is covered with a thick growth of weeds and a forest of pine-trees, and is so effectually shaded from solar radiation that variations of temperature in the cave are too small to be recorded by the ordinary thermograph. The instrument is 28 feet above mean sea-level, 25 yards from the nearest beach-line, and less than a quarter of a mile from the tide-gauge station of Aburatubo Bay. Mr. Takahasi shows that the tilting of the crust follows quite faithfully the ebb and flow of the oceanic tides, a rise of 13 inches in the sea-level at Aburatubo producing a tilt of 0·22″ at Misaki. The observed tilting is almost entirely the effect of tidal loading, other causes leading to a deflection of less than 0·01″. In the Bay of Aburatubo, remarkable seiches with a period of 15 minutes are sometimes observed, and the record of the tiltmeter is then serrated by minute indentations with a mean period of 15 minutes. The seiches were recorded at various points of the Bay, and it was found that the tiltmeter record follows the curve of seiches obtained at a point 25 yards from the station, but not one at a point 160 yards distant. In other words, the load that is really effective in promoting tilting is that applied at a distance of less than 160 yards.

Copper Deposits of Michigan.—*Prof. Paper* 144 of the U.S. Geological Survey, by B. S. Butler and W. S. Burbank, deals with this important subject. The

Michigan copper region is on the southern rim of the Lake Superior basin, which was probably formed during Keweenawan time. Since 1845 the output has been about 35 million tons of copper. In late pre-Cambrian times a series of basaltic flows accumulated to a depth of thousands of feet. The dense rock that forms the greater part of the main flows is everywhere overlain by more open-textured 'amygdaloid'. The tops of nearly all the flows are distinctly red, and it is thought that the oxidation and concentration of the iron were accomplished in large part by the gases given off during the solidification of the lavas. Examination of the freshest flows confirms previous observations that they contain both native copper and chalcopyrite in small amount. It therefore seems probable that at least part of the copper is a primary constituent. The workable deposits are of two main classes—lode deposits and fissure deposits. The former are mineralised beds of either (*a*) felsite-conglomerate interbedded with the lava flows, or (*b*) vesicular or brecciated amygdaloid 'tops'. The fissure deposits are narrow tabular veins along fractures parallel or transverse to the beds. The hypothesis of origin from descending waters is shown to be untenable. The authors favour the view that the copper was derived from sulphide-bearing solutions originating in the underlying Duluth gabbro-magma.

Climate of the Dutch East Indies.—The Koninklijk Magnetisch en Meteorologisch Observatorium in Batavia has now published vol. 2, pt. 3 of the monograph on the climate of the Dutch East Indies. This completes the detailed discussion of the meteorological conditions of the islands, and covers Borneo, the Celebes, the Moluccas, New Guinea, and smaller islands. Some of the accounts are necessarily incomplete for want of data, but, taken as a whole, the monograph is most comprehensive. The editor, Dr. C. Braak, promises a third volume, with climatological tables, in the course of time. The monograph is naturally in Dutch, but the English summaries added to all chapters are so full as almost to contribute a condensed monograph in English.

Flow of Swedish Rivers.—Some instructive charts illustrating the amount of discharge of Swedish rivers are published in a paper by G. Slettenmark in *Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt*, Bd. 4, No. 5. One chart shows the mean flow of all the rivers that have a discharge of at least 5 m.c. per second. The breadth of the river is made proportional to the flow. The next two charts show the mean flow of the chief rivers at high and low water respectively. The final chart shows the area of the lakes in the drainage area of each river basin. It appears that in spite of the number of rivers in Sweden, 74 per cent of the total drainage is supplied by fourteen rivers. Details of the flow of the principal rivers are given in tables.

Recombination of Gaseous Ions.—In the September issue of the *Journal of the Franklin Institute*, Profs. Loeb and Marshall, of the University of California, discuss the bearing of recent research on the theory of the mechanism which determines the recombination of gaseous ions. According to Langevin, it is mainly the attraction of the two oppositely charged ions which determines their recombination. The authors show that recent observations do not accord with this view, but give some support to the Thomson theory that recombination is due mainly to the random movements of the ions due to their heat energy. They point out that the theory is incomplete owing to our want of knowledge of the masses of the ions and therefore of their speeds. They believe that these masses are to a great extent determined by the impurities in the gas, such as organic molecules from the stopcock greases, and that this accounts for the rates of recombination in different gases being found experimentally nearly alike, although from the constitutions of the gases we should expect them to differ.

Diffraction in Spectrometers.—Prof. A. G. Shenstone points out in a paper in the first September number of the *Physical Review* (p. 726), that the optical system of a spectrometer is one which is very well suited for the production of diffraction fringes round the positions of maximum intensity—the 'lines' of the spectrum—on the recording plate, and some photographs which he has reproduced show that such fringes are actually present in a well-adjusted instrument. A theory applicable to this effect was given many years ago by the late Lord Rayleigh, but does not appear to cover the numerous anomalies in relative intensity and spacing of the fringes which occur, and these Prof. Shenstone consequently attributes to peculiar forms of aberration in the lenses of modern spectrographs. The presence of the fringes is of considerable practical importance; they prevent the ideal resolving power of an instrument from being attained in the separation of two neighbouring lines of unequal intensities, and could also be easily mistaken for fine structure components of feeble intensity with an echelon spectrograph, whilst in the study of scattered radiation exactly the condition which makes it possible to photograph Raman lines near the exciting line is the condition that brings out the fringes, namely, great homogeneity of the unmodified radiation. In interpreting Raman spectra it is thus essential that the existence of the fringes should not be forgotten.

Electrical Resistance in Metals.—The Institute of Metals has published in pamphlet form (price 5*s*.) the interesting May lecture delivered by Sir Oliver Lodge this year. The title of the lecture, "States of Mind which make and miss Discoveries, with some Ideas about Metals", well describes its contents. Zeeman's discovery and Lodge's own failure to discover the Hall effect are convincingly told. Faraday wholly failed to find any relation between gravitation on one hand and electricity and magnetism on the other. Einstein and others are now finding it theoretically and not by experiment. It has to be remembered that the fact that light would be deflected by a gravitational field was first predicted by theory and then verified. The splendid discovery made by Kammerlingh Onnes at Leyden that a few metals became perfect conductors at an excessively low temperature is admittedly of the first theoretical importance. How can a metal offer such a small resistance to an electric current that a current induced in a loop of it, which usually dies out in a fraction of a second at ordinary temperatures, takes hours or even days to die away when the temperature is sufficiently low? Lodge suggests that the crystalline metal arranges itself in chains from one end of the rod to the other. Unobstructed interstices are left along which the electronic 'gas' moves freely instead of being constantly checked and hampered by encountering the nuclei of atoms in its path. In free space an electron can go on for ever, and this is what the amperean currents which constitute magnetism are always doing. It is surmised that there is a perpetual flow of some kind along every magnetic line of force. Methods of experiment which produce intense magnetic fields, such as those used by Kapitza, may lead to the discovery of an actual etheric circulation.

Research on Motor Fuel.[1]

THE National Benzole Association now presents its sixth annual report embodying the results of certain technological investigations carried out under the auspices of a joint research committee of this Association and of the University of Leeds. The term 'benzole' is used in this report to indicate the mixture of hydrocarbons, mainly aromatic, which is ordinarily recovered from coal gas or coke-oven gas for use as motor spirit.

The study of resin formation in benzoles continues to occupy the major portion of the Committee's attention. It had previously been shown (Report No. 5, 1928) that the tendency of benzole to gum, either on storage or on oxidation, could be greatly diminished if not altogether prevented by the addition of an inhibitor. The particular reagent used in this connexion was tri-cresol. This tri-cresol is a commercial product consisting of a freshly distilled, technically pure, phenolic fraction boiling over a range of 195°-203° C. and having a low sulphur content. Concentrations of approximately 0·03 per cent by weight of tri-cresol were found to give an optimum content of inhibitor. The report for 1929 records an extension of these investigations to large scale and prolonged tests in commercial engines, and it has been shown, although the Committee wishes the results to be regarded in the meantime as tentative, that benzoles stabilised by an inhibitor are little, if any, inferior to those purified by acid. It has further been shown that dilution of unstabilised benzole with petrol retards resinification to a greater extent than would be accounted for by the concentration of unsaturateds. This is an important point, since most benzoles are used to-day as motor fuels in admixture with petrol.

[1] The National Benzole Association. Sixth Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds. Pp. ii+212. (London: The National Benzole Association, 1929.) n.p.

The efficiency of various types of oils for absorption purposes has been examined, and it has been shown that oils from low temperature and Bergius tars have nothing to recommend them for use in preference to oils from high temperature tar, whilst they have the disadvantage of being in themselves much more unstable. An examination of the variation with temperature in the absorption capacity of creosote and gas oils, both in everyday use as wash oils, has also been made and a chart drawn, from which the capacity at any desired temperature can be read off.

The Committee has prepared correction tables to be applied to hydrometer readings and volumes, so that the correct value at the standard temperature of 65° F. can be calculated. These tables will be of great use for commercial and technical purposes.

Tests have also been carried out on the purification of benzoles by the Ufer and Instill processes, which aim at removing either wholly or partially the components which cause resinification. Moreover, the report contains the annual report of the Engine Tests Sub-Committee for 1928, a very full bibliography of all literature relevant to fuels, and is liberally illustrated by tables, graphs, and photographs.

The Research Committee of the National Benzole Association is to be congratulated on the results obtained in these researches on problems of practical importance. To both manufacturers and users of benzole the successful issue of the work carried out by the Committee is of vital interest. The harmonious co-operation of other companies such as the Gas Light and Coke Co., Ltd., and the Staffordshire Chemical Companies, shows the interest exhibited by the trade and ensures the practical utility of the results. Criticism of and contribution to the subjects under investigation are welcomed and should be sent to Prof. J. W. Cobb, the secretary of the Committee, at the Department of Fuel Technology, University, Leeds.

Carbohydrates and their Digestion.

FOR an accurate system of dieting it is essential to know the content of different foodstuffs in digestible protein, fat, and carbohydrate: analyses by different authors differ somewhat in the case of protein and fat, but diverge widely in that of carbohydrate, where accurate knowledge is essential for the planning of diets for diabetics. Moreover, the analyses are usually only of raw foods and the results are expressed solely in terms of total carbohydrate. Now, as McCance and Lawrence[1] point out, of the total carbohydrate content, part is available and part unavailable as carbohydrate in the body: the former consists of starch, sucrose, glucose, and fructose, and the latter mainly of fibre and the hemicelluloses. They therefore determined to analyse foods for their carbohydrate content, differentiating between the two fractions and taking the foods as eaten, raw or cooked according to the usual custom. The results, in brief, were that the available carbohydrate was found to be much lower than had previously been supposed.

Only vegetables and fruits were analysed, since they form the chief sources of carbohydrate in the diet apart from the concentrated starchy foods, such as bread, etc., earlier analyses of which are reasonably accurate. The food was hydrolysed by boiling with dilute hydrochloric acid for one or two hours, and the digest neutralised and filtered. Total reducing sugars were estimated on the filtrate by Benedict's method, and pentoses by McCance's method: the principle of the latter is the conversion of the pentose to furfural by heating with hydrochloric acid, extraction with benzene and treatment with benzidine acetate, the colour formed being compared with that produced by a standard solution of arabinose similarly treated. The conversion to furfural is not quantitative, so that the result obtained must be multiplied by an empirical factor experimentally determined: the factor used differs also for the various pentoses. In some cases the non-fermentable reducing sugars were also estimated. The available carbohydrate is considered to be the total less the pentose or non-fermentable sugar, except in the case of the inulin vegetables, in which only one quarter of this difference is considered to be available. Full details of the results obtained are given in the original monograph, which should be consulted by those interested: some points of interest are that the pentose and total sugar content are completely independent, that the non-fermentable sugars are chiefly pentoses, that olives alone contain no fermentable sugar after hydrolysis, and that appearance and taste are little guide as to sugar content.

The application of the results to diabetic dietaries is briefly referred to by the authors in the *Brit. Med. Jour.*, vol. 2, p. 241; 1929. Diabetics can now take larger amounts of vegetables; some, such as lettuce,

[1] Medical Research Council. Special Report Series, No. 135: The Carbohydrate Content of Foods. By R. A. McCance and R. D. Lawrence. Pp. 73. (London: H.M. Stationery Office, 1929.) 2*s*. net.

asparagus, and rhubarb, contain so little carbohydrate that they may be allowed as extras. The larger ratio of carbohydrate permitted brings up the actual allowance to the theoretical and provides a better balance for the fat in the diet, with the result that the patients less frequently excrete acetoacetic and hydroxybutyric acids, the products of incomplete fat combustion.

McCance, in the second part of the M.R.C. monograph, takes the opportunity of reviewing the digestibility of the carbohydrate which is unavailable as such to the body: the available may be considered as being completely digestible; it can be removed from a plant by warm water or by diastase. Of the unavailable, the fibre resists the action of dilute acids and alkalies, while the hemicelluloses are hydrolysed by boiling in 1-3 per cent mineral acid.

The fibre consists chiefly of cellulose, with small amounts of oxycellulose, lignin, and resistant pentosans. The hemicelluloses are composed of pentosans—the anhydrides of xylose and arabinose—and other furfural precursors, inulin, and fructosans or other hexosans such as mannans and galactans, or the two acids galacturonic and glycuronic: free pentoses are not found in significant amounts. The different components are present in different quantities in the different foodstuffs: thus inulin occurs chiefly in artichokes, chicory, and salsify. Some of them are of no value; thus lignin, consisting of aromatic alcohols, is not digested at all, whilst the uronic acids may be neglected as sources of energy.

The amounts digested are approximately, for cellulose, 30-85 per cent, depending on the species: herbivora digest the most, carnivora the least. Pentosans are digested somewhat better, fructosans and other hexosans to about 75 per cent of the intake. The mechanism of digestion appears to be similar in all cases but has been most studied in that of cellulose.

The enzyme cellulase, which hydrolyses cellulose to cellobiose and glucose, occurs only in certain invertebrates, such as snails and some insects: none of the higher animals secrete it. It is found occasionally, however, in the alimentary tract, having been ingested with the food when taken in its natural state; but except when large quantities of cellulose-containing foodstuffs are eaten raw, any possible autolysis of the food can be neglected as a method of digestion. The hydrochloric acid of the stomach is too weak to effect much hydrolysis: and little, if any, of these complex carbohydrates is absorbed unchanged. The chief agents effecting the digestion are the bacteria living in the alimentary canal: the products of the reaction are organic acids, lactic, acetic, butyric, etc., carbon dioxide, hydrogen, and methane. In most cases the cellulose is first hydrolysed to glucose, but since this sugar is not found among the products of the reaction nor absorbed from the gut, the second reaction, the fermentation of the glucose, must proceed at a faster rate than the hydrolysis of the cellulose. The same end products are formed when the organisms are grown anaerobically *in vitro*.

The value of these carbohydrates as sources of energy is reduced by the fact that some of the products of their breakdown are gaseous and that numerous side reactions occur together with the main fermentation. For animals with a voluminous large intestine, such as the cow, consuming large quantities of cellulose-containing foodstuffs, 6 to 9 cal. per kgm. body weight per diem may be available from the digestion of cellulose, and 5 cal. from the pentosans consumed: for man, these carbohydrates have a negligible value as sources of energy, about 0·3 and 0·5 cal. per kgm. per diem respectively. They cannot be used to replace other foodstuffs in the diet from this point of view.

On the other hand, they have a definite place in the diet, since they exert a laxative action: this is due either to a direct mechanical irritation of the gut wall, stimulating peristalsis, or to their passing through the gut unchanged and so adding bulk to the fæces, or to their power of swelling in the presence of water. A most important factor, however, is a stimulation of the secretion of the intestinal glands by the products of their digestion, resulting in increased bulk and softness of the fæces.

The unavailable carbohydrates are therefore available in the form of the lower fatty acids in small quantities: of these only lactic acid occurs in the path of carbohydrate metabolism, the others being more closely connected with the metabolism of the fats.

New Extension of the Polytechnic, London.

THE Polytechnic in Regent Street, London, is assured of the public goodwill, because it was the first important institution to assume that name, through accident rather than by design, and because it has faithfully adhered to its original purposes—a rare phenomenon in English educational history. Founded by Quinton Hogg in 1882, the Polytechnic was and remains "an educational centre and also a club and rendezvous for young people between the ages of sixteen and twenty-six, where every reasonable facility shall be offered for the formation of steadfast character and true friendships; for training mind and body and for leading an upright and unselfish life". In 1910–11 the front portion of the Regent Street premises was rebuilt at a cost of £115,000. On Oct. 10, the Queen opened a new extension off Great Portland Street, an admirable building designed by Mr. F. J. Wills. Apart from a physics laboratory, the new building is to be used for commercial and technical education—domestic science, hairdressing, laundry, dressmaking, tailoring, etc.—and for social purposes. It furnishes a good example of modern methods of building. There is a complete wireless installation for reception and dispatch; a secondary system of lighting; two halls can be formed by the lowering of a screen; and many other new ideas are incorporated in the building.

Of particular interest in the new extension of the Polytechnic is the novel heating equipment which has been installed by Messrs. Sulzer Bros., Ltd. An electric boiler of 1850 kw. capacity is employed, operating directly off the 6600-volt, three-phase, 50-cycle mains. The high tension current is passed directly through the water by means of three iron electrodes, the tank itself being well earthed. The plant is automatic in its operation, changes in load being counteracted by means of three insulating cylinders surrounding the electrodes. These cylinders are raised or lowered automatically by means of a small hydraulic motor, in this way varying the effective distance between the electrodes so as to maintain a constant load on the boiler. The latter feeds the heated water into three large, well-lagged storage tanks, the total capacity of which is 27,000 gallons.

The boiler is only used during the night period, so as to take advantage of the special tariff rates offered by the Borough of St. Marylebone Electricity Depart-

ment for night load. The temperature of the water in the storage tanks is thus gradually raised during the night, for use throughout the following day. The temperature of the water in the radiators and circulating pipes throughout the building is, however, not so high as that in the storage tanks, a certain proportion of cold water being added in order to bring the temperature down to the desired value. In the morning, when the storage tanks are at their hottest, a larger proportion of cold water is needed than later on in the day, when the temperature of the storage tanks has fallen. By suitably varying the proportion of hot and cold water the temperature of the building can be maintained at a constant predetermined figure.

University and Educational Intelligence.

Cambridge.—At Trinity College the following have been elected to fellowships: C. F. A. Pantin, M. Black, N. Feather, J. A. Gaunt, and H. D. Ursell.

The Council of Gonville and Caius College has appointed E. P. Weller, University Lecturer in Estate Management, as Bursar.

For the ninth year in succession Trinity College, Cambridge, announces the offer of a Research Studentship open to graduates of other universities who propose to come to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1930.

The same College offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial Universities who wish to come to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These Exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the Exhibitioner's financial circumstances. If it is made clear that the financial need of an exhibitioner cannot possibly be met by the payment to him of the full amount of his titular emolument, the Council has power, if it sees fit and if funds are available, to award him an additional payment. Candidates must apply through the principal authority of their University, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1930.

Manchester.—The following appointments have been made:—Assistant-Lecturer in Botany: Miss Barbara Colson; Demonstrator in Pathology: Mr. Raymond Whitehead; Lecturer in Metallurgy and Assaying: Mr. Cecil Handford; Assistant-Lecturer in Mechanical Engineering: Mr. B. J. Tams.

The Board of Education has just issued a new list (List 111) of the more important recognised institutions of technical and art education and other forms of further education in England and Wales (London: H.M. Stationery Office, 1929. 4*s*.). The list includes technical day classes, junior technical schools, etc. The postal address of each institution is given, and, for colleges and technical day classes, an indication of the courses and branches of study followed. Particulars are given of approved schemes in operation for national certificates in mechanical and electrical engineering, chemistry, naval architecture, and gas engineering.

Calendar of Patent Records.

October 20, 1830.—The patent granted on Oct. 20, 1830, to Admiral Sir Thomas Cochrane, afterwards the tenth Earl of Dundonald, for "apparatus to facilitate excavating, sinking, and mining" was an important one in the history of tunnelling, the invention being for the introduction of air under pressure into the tunnel for the purpose of keeping back the water and holding up the face of the excavation. The specification included most of the essential features—such as the air-lock before the working chamber—which have characterised the use of the process since the time of the invention. The system was adopted at first only for shaft sinking, the first application being at Chalonnes on the Loire. It was not until 1879 that it was used for tunnel work, in an attempt to tunnel under the Hudson River at New York, and in the same year at Antwerp.

October 21, 1824.—Portland cement was invented by Joseph Aspdin, a stone-mason of Leeds, and was patented by him on Oct. 21, 1824. Aspdin established a factory to produce the cement at Wakefield in 1825, and the success of the industry may be gauged by the fact that the annual consumption in the world to-day is upwards of thirty million tons. In 1924 a tablet, presented by the American Portland Cement Association, was erected in the Leeds Town Hall to commemorate the centenary of the invention.

October 22, 1832.—George Frederick Muntz, of Birmingham, was granted a patent for his invention of "an improved manufacture of metal plates for sheathing the bottoms of ships and other such vessels" on Oct. 22, 1832. 'Muntz metal' entirely superseded copper sheathing in the mercantile marine, though not in the Navy, and brought the inventor a profit of £70,000. The patent was unsuccessfully attacked in the courts, but an application for its prolongation was refused.

October 23, 1820.—The employment of wrought-iron rails for railways in place of the cast-iron rails formerly in use was mainly due to John Birkinshaw, manager of the Bedlington Iron Works, who on Oct. 23, 1820, was granted a patent for "Improvements in the manufacture and construction of a wrought or malleable iron railroad or way". In the specification he describes as his preferred form a T-section rail to be made in 18-foot lengths.

October 23, 1835.—The process under which the 'Baxter' prints were produced was patented by George Baxter, wood engraver, on Oct. 23, 1835. The first publication was in 1837, when Baxter issued his "Pictorial album or cabinet of paintings containing eleven designs executed in oil colours from the original pictures". The life of the patent was extended for five years.

October 24, 1832.—The first commercially successful hydraulic turbine—which was of the reaction type—was invented by Benoit Fourneyron of Besançon, and patented by him in France on Oct. 24, 1832, under the title of "Roue à pression universelle et continue". The original turbines for the Niagara Falls Power Company were of the Fourneyron type, built in Philadelphia, and they remained in service for fifteen years.

October 24, 1850.—The 'mercerisation' process for treating cotton and cotton fabrics is due to John Mercer, F.R.S., who patented the invention on Oct. 24, 1850. Mercer's specification describes the effect of caustic soda in strengthening the fibre and making it more receptive to dyes, but does not mention the 'lustre' effect, which was not discovered till forty years later by H. A. Lowe. Samples of mercerised cotton received special mention at the Great Exhibition of 1851.

Societies and Academies.

ROME.

Royal National Academy of the Lincei, June 1.—**F. Severi**: The whole of the singular points of an analytical function of several variables.—**Guido Fubini**: Further with regard to the canonical cluster.—**Q. Majorana**: Optical telephony by means of ultra-violet or infra-red rays. Improved results have now been obtained as a result of modification of the arrangement of the apparatus. By means of filtered infra-red light from a 500-watt incandescent lamp, telephonic communication has been established between stations ten kilometres apart, excellent reproduction of the words being obtained.—**L. Lombardi and Paolo Lombardi**: Behaviour of the moving-coil transformer in constant current circuits.—**A. Angeli**: The constitution and reactions of the diazo-hydrates. Hantzsch's views on the structure of the diazo-hydrates are refuted, Swietoslawski's thermochemical data being quoted in support of the structures advanced by the author.—**G. Tizzoni and G. De Angelis**: Immunity against cancer conferred on animals by phenolate auto-vaccine. The results of numerous experiments on white mice show that immunity against Ehrlich's adenocarcinoma may be attained by the use of phenol, which converts the cancerous matter into vaccine. The phenol is administered in 0·5 per cent solution for a period of 24-72 hours, the immunity appearing 11 days later and persisting for more than 4 months.—**Giuseppe Levi**: A differentiation of nerve cells.—**G. Levi and G. C. Dogliotti**: The structure of adipose cells. The adipose cells of the adult rat exhibit a very thin cytoplasmic film containing a large number of chondriosomes in the form of granules and short rods, the view that adipose cells are composed of an adipose drop contained in a reticular envelope being hence inadequate.—**M. Kourensky**: Riccati's equation.—**Pia Nalli**: A generalised displacement in Riemannian spaces.—**U. Cassina**: The conception of vectors.—**B. Segre**: Continuous systems of plane curves with tacnode.—**E. Čech**: A characteristic property of Fubini's surfaces.—**L. S. Da Rios**: Wings and helices.—**E. Fermi**: The motion of a body of variable mass.—**G. Viola**: Pendular oscillations in the elliptic elements of the variable W Ursæ majoris.—**M. Pierucci**: Concerning recent experiments on thin metallic films. Results lately obtained support the view that conductors electrically charged undergo a variation in resistance.—**D. Graffi**: Demonstration of the formula of retarded potentials by the method of functional operators.—**F. Neri**: The auto-excitation of auto-compensated asynchronous machines.—**Remo de Fazi**: Syntheses in organic chemistry by means of radiant energy (3). Acenaphthene and benzaldehyde. A benzene solution of benzaldehyde and acenaphthene, exposed in a sealed glass tube to sunlight for two years, yielded a trimeride and a tetrameride of benzaldehyde, stilbene, isostilbene, a resinous substance, and a compound formed by the condensation of one molecule of acenaphthene and one molecule of benzaldehyde with loss of one molecule of hydrogen.—**O. Scarpa**: Concentration, wholly metallic piles acting at variance with Volta's law. Measurements at constant temperature (18°) of the electromotive force of the cells, platinum-zinc amalgam-mercury-platinum, and platinum-cadmium amalgam-mercury-platinum, give values which vary linearly with the concentration of the amalgam in the case of zinc and almost linearly in that of cadmium within the limits of composition for which the amalgams exist as monophase liquid systems.—**G. A. Barbieri**: Ferrocyanomolybdates and analogous compounds of ruthenium and osmium. When introduced into ammonium acetate solution, the reddish-brown, gelatinous precipitate obtained by the interaction of a molybdate and a ferrocyanide in acid solution is transformed into a canary-yellow, crystalline compound, $(NH_4)_4Fe(CN)_6$, $2MoO_3$, $3H_2O$. The ready conversion of this into the silver compound, $Ag_4Fe(CN)_6$, $2MoO_3$, H_2O, points to the existence of the complex $[Fe(CN)_6, 2MoO_3]$, the structure of the ammonium compound being probably

$$[MoO_3(CN)_3Fe(CN)_3MoO_3](NH_4)_4.$$

The corresponding ruthenocyanomolybdate and osmiocyanomolybdate have analogous formulæ.—**G. R. Levi and A. Baroni**: Diethyl triselenide, sulphodiselenide, and selenodisulphide. Diethyl triselenide, $(C_2H_5)_2Se_3$, is obtained by the action of selenium oxychloride on selenomercaptan or by that of selenium on diethyl diselenide; diethyl sulphodiselenide, $(C_2H_5)_2Se_2S$, by the action of mercaptan on selenium chloride or oxychloride, or that of selenium on diethyl disulphide, and diethyl selenodisulphide, $(C_2H_5)_2SeS_2$, from either selenomercaptan and thionyl chloride or sulphur and the diselenide. The progressive replacement of the sulphur of these compounds by selenium is accompanied by marked increases in the densities and refractive indices.—**L. De Caro**: Molecular weight of myoprotein, determined by Du Noüy's surface tension method. Determinations of the surface tension of the myoprotein of the dog dissolved in water in presence of a trace of sodium hydroxide show that the static surface tension, before reaching the corresponding dynamic value, exhibits three characteristic minima at the dilutions 1 : 37000, 1 : 55000, and 1 : 80000. On the assumption that these minima correspond with the formation of monomolecular layers of different orientations, the dimensions of the molecular parallelepiped are calculated to be 225·6, 151·7, and 104·3 A. respectively. The volume of the molecule is thus 3569513×10^{-24} c.c., its mass 2644084×10^{-24} gm., and the molecular weight 1602843, but other considerations indicate that the last figure is too high for anhydrous myoprotein. Approximately, however, the proportion of myoprotein in muscle suffices to cover the total surface of the myofibrils with a monomolecular layer.—**G. Quagliariello**: Sodium, potassium, calcium, and magnesium in muscular fluid and in its ultra-filtrate. Examination of the muscular fluid of the dog shows that the whole of the sodium in the fluid, together with about two-thirds of the potassium and three-fifths of the calcium and magnesium pass through a collodion ultra-filter.—**L. Maddalena**: Geological results of the boring of the tunnel of the direct Bologna-Florence line through the Tuscan-Bolognese Appenines.—**G. Martino**: Behaviour of the phosphogens in muscular tetanus.—**M. Tirelli**: Tropism phenomena in the larvæ of *Bombyx mori*.

CAPE TOWN.

Royal Society of South Africa, Aug. 21.—**C. K. O'Malley**: On the cleaning up of civilisation.—**J. H. Ferguson**: On living leucocytes. A drop of human blood examined by the dark-ground illumination method in a warm-chamber at 37° C. shows: (1) Colloidal particles and 'hæmokonia' in Brownian movement in the plasma; (2) Red cells; (3) White cells. The leucocyte nucleus exhibits a fundamental degree of lobulation for each cell. Nucleoli are prominent only in young cells. The cytoplasm shows a clear structureless hyaloplasm containing oscillating refractile particles or granules of various kinds. Mitochondria and vacuoles are noted.—**B. F. J.**

Schonland: A proposed method of locating underground water and some experiments thereon. A beam of short Hertzian waves incident at an angle of 45° upon the interface between dry earth or rock and underground water should undergo reflection, and calculation for a wave-length of two metres indicates that the reflected intensity should amount to about 50 per cent of the incident intensity. Apparatus for the production and detection of such beams is described, measurements being made with a portable galvanometer, on a wave-length of 1·8 metres. Interference between direct and reflected radiation has been observed, which suggests a possible modification of the method.

SYDNEY.

Linnean Society of New South Wales, Aug. 28.—**W. W. Froggatt**: Notes on gall-making coccids and descriptions of new species. Description of a new species of *Apiomorpha* found on *Eucalyptus pilligœnsis*, and three new species of *Opisthoscelis* found on other Eucalypts.—**W. Greenwood**: The food plants or hosts of some Fijian insects (3).—**I. V. Newman**: The life-history of *Doryanthes excelsa* (2). The gametophytes, seed production, chromosome number and general conclusion. The germination of the spores is described with special reference to the part played therein by vacuolation of the cytoplasm. By using its cellulose plugs for identification, the pollen tube is traced from the stigma to the synergids. Fertilisation and triple fusion, though not observed, are inferred. The chromosome number is: haploid 22, diploid 44, triploid (endosperm) 66. *Doryanthes excelsa* is concluded to be primitive among the Amaryllidaceæ and even in the Agavoideæ group of the family.

Royal Society of New South Wales, Sept. 4.—**A. R. Penfold and F. R. Morrison**: The occurrence of a number of varieties of *Eucalyptus dives* as determined by chemical analyses of the essential oils (Pt. 3). The present investigation is confined to an examination of specimens from Victoria. The type yielding an oil containing 50 per cent of piperitone is the predominating tree in many important areas, whilst in others such as at Blackwood, only var. *A* containing 5 per cent of piperitone was observed. In other localities where it was previously difficult to account for oils containing only 26-36 per cent of piperitone, careful field observations showed both the type and var. *A* were growing together. Samples of leaves and terminal branchlets, and the results of the examination of the essential oils obtained therefrom confirmed the field observations.

Official Publications Received.

BRITISH.

Journal of the Chemical Society: containing Papers communicated to the Society. September. Pp. iv+1847-2172+x. (London.)

Madras Fisheries Department. Administration Report for the Year 1927-28. By Dr. F. H. Gravely. (Report No. 1 of 1929, Madras Fisheries Bulletin, Vol. 23.) Pp. vii+86+4 plates. (Madras: Government Press.) 14 annas.

Indian Journal of Physics, Vol. 4, Part 4; and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 4. Conducted by Sir C. V. Raman. 15: Bibliography of 150 Papers on the Raman Effect. By Dr. A. S. Ganesan. Pp. 281-348. (Calcutta.) 1.8 rupees; 2*s*.

The Indian Lac Association for Research. Bulletin No. 2: Physical Properties of Shellac Solutions, Part 2. By M. Rangaswami and M. Venugopalan. Pp. 17+6 plates. (Ranchi.)

Transactions of the Institute of Marine Engineers, Incorporated, Session 1929. Pp. 553-620. (London.)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Salop. A Progress Report of Instructional and Experimental Work in Poultry and Rabbit Husbandry. Pp. 72. (Newport, Salop.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1929-1930. Pp. 96. (Edinburgh.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1929. Pp. 29. (Wakefield.)

Tanganyika Territory: Geological Survey. Annual Report, 1928. By Dr. E. O. Teale. Pp. 48+4 plates. (Dodoma.) 4*s*.

The Quarterly Journal of the Geological Society. Vol. 85, Part 3, No. 339, September 23rd. Pp. cxxix-cxli+223-388. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1928-9. Pp. 54. (London: The Crown Agents for the Colonies.) 5*s*.

Observations made at the Royal Observatory, Greenwich, in the Year 1927 in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii+A108+B16+Cix+C139+D62+E46+18. (London: H.M. Stationery Office.) 37*s*. 6*d*. net.

Progress of Education in India, 1922-27. Ninth Quinquennial Review. By R. Littlehailes. Vol. 1. Pp. vii+287+xvii. 1.10 rupees; 2*s*. 9*d*. Vol. 2: Appendices and Tables. Pp. iv+235. 2.10 rupees; 4*s*. 9*d*. (Calcutta: Government of India Central Publication Branch.)

Far Eastern Association of Tropical Medicine. Transactions of the Seventh Congress held in British India, December 1927. Edited by Lt.-Col. J. Cunningham. Vol. 2. Pp. xvi+871+26 plates. (Calcutta: Thacker's Press and Directories, Ltd.)

Durban Corporation. Museum Report for the Municipal Year ended 31st July 1928. Pp. 4. (Durban.)

The Scottish Association for the Deaf. First Annual Report (1928-29). Pp. 19. (Glasgow.)

Annual Report for the Year 1928 of the South African Institute for Medical Research, Johannesburg. Pp. 87+2 plates. (Johannesburg.)

FOREIGN.

Bulletin of the National Research Council. No. 71: Bibliography of Bibliographies on Chemistry and Chemical Technology. First Supplement 1924–1928. Compiled by Clarence J. West and D. D. Berolzheimer. Pp. 160. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

Scientific Papers of the Institute of Physical and Chemical Research. No. 200: The Internal Strain of Uniformly Distorted Aluminium Crystals. By Keiji Yamaguchi. Pp. 151-169 + plates 4-8. 45 sen. No. 201: Beiträge zur Chemie der Viskose. Von Gen-itsu Kita und Rikimatsu Tomihisa. Pp. 171-192. 30 sen. No. 202: Absorption of Hα Line. By Toshio Takamine and Taro Suga. Pp. 193-197+plate 8. 20 sen. No. 203: The Raman Spectra of Calcite, Aragonite and Water Solution of Potassium Carbonate. By Masamichi Kimura and Yōichi Uchida. Pp. 199-204. 15 sen. (Tōkyō: Iwanami Shoten.)

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 7, No. 1. Pp. ii+45+10. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tōhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 11, No. 3: Tertiary Foraminiferous Rocks of the Philippines. By Hisakatsu Yabe and Shōshirō Hanzawa. Pp. 54+13 plates. (Tōkyō and Sendai: Maruzen Co., Ltd.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 59: Vergleich der Fangfähigkeit verschiedener Modelle von Plankton-netzen. Von Cl. Künne. Pp. 37. 1.50 kr. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 1. 24 planches. (Copenhague: Andr. Fred. Høst et fils.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 10, Part 2: The Fishes of Porto Rico and the Virgin Islands. Branchiostomidae to Sciaenidae. By J. T. Nichols. Pp. 161-295. (New York City.)

Technical Books of 1928: a Selection. Twenty-first Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig, Mathematisch-physische Klasse. Band 80, 1928, Heft 7 (Schlussheft). Pp. xxxvii+497-507. (Leipzig: S. Hirzel.) 1·50 gold marks.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Livraison 4, Avril. Pp. 331-455+plates 6-9. (Buitenzorg.) 2.50 f.

CATALOGUES.

Small Electric Furnaces for Laboratory and Works. (List No. 75E.) Pp. 20. (London: A. Gallenkamp and Co., Ltd.)

Pituitary (Posterior Lobe) Extract B.D.H. Pp. 12. (London: The British Drug Houses, Ltd.)

Microscopes and Accessories, 1930. Pp. 103. (London: C. Baker.)

Cambridge Gas Analysers, Electrical Type. (List No. 144.) Pp. 24. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Wilmot Herringham: Harveian Oration.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Trephining—Ancient and Modern.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. D. Adamson: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—R. Hamilton: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange, Swansea), at 7.30.—Dr. A. C. Edwards: The Chemistry of Tinplate Manufacture.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—Miss G. Burlton: Personal Salesmanship in the Electrical Industry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Willox: Some Recent French Railway Construction.
ROYAL SOCIETY OF MEDICINE (Obstetrics and Comparative Medicine Sections), at 8.—Discussion on Causes of Early Abortion and Sterility.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. C. A. Robinson: Presidential Address.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. Tagliani: The Application of the Locust Beans in the Textile Industry and especially in the Calico Printing Trade.

SATURDAY, OCTOBER 19.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—Modern Improvements in Wireless.
PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

MONDAY, OCTOBER 21.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens illustrating Tumours of the Brain.
TEXTILE INSTITUTE (London Section) (at Clothworkers' Hall), at 6.—R. G. Parker: Woollens from the Launderer's Point of View.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—Prof. E. W. Marchant: Chairman's Address.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—S. Scott Hall: Safety in Flight.
SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry, Leeds Area Section) (at Great Northern Station Hotel, Leeds), at 7.15.—Prof. R. W. Whytlaw Gray: Phenomena Associated with Finely Divided Particles in Air.
KEIGHLEY TEXTILE SOCIETY (at Keighley), at 7.30.—A. T. King: Wool viewed as a Chemical in its Formation and Processing.

TUESDAY, OCTOBER 22.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. W. J. Adie and others: Diseases of the Pituitary Body.
NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (at Technical College, Stoke-on-Trent), at 5.
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of May, June, July, August, and September 1929.—D. Dewar: The Margaret Pennington Bequest to the Society: Water-colour Drawings of Indian Birds by the late General Sharpe.—R. Lovell: The Bacteriological Findings in certain Fatal Cases of Enteritis occurring in the Society's Gardens during 1928.—Dr. Isabella Gordon: On Species of the Galatheid Genus *Eumunida* (Crustacea, Decapoda).
ILLUMINATING ENGINEERING SOCIETY (at Chamber of Commerce, Birmingham), at 7.—R. Maitland: Architectural Lighting.
ROYAL PHOTOGRAPHIC SOCIETY OF LONDON, at 7.—J. D. Johnston: Presidential Address.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.30.—T. E. Herbert: Chairman's Address.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at Glasgow), at 7.30.—J. MacLeod: The Steam Turbine Locomotive.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at St. Enoch Station Hotel, Glasgow), at 8.—T. Ramsay, Dr. H. Levinstein, H. J. Pooley, and others: Discussion on The Outlook in Chemical Industry in Great Britain, with Special Reference to the West of Scotland.
WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.

WEDNESDAY, OCTOBER 23.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—R. D. Oldham: Historic Changes of Level in the Delta of the Rhone.—R. W. Pocock: The *Petalocrinus* Limestone Horizon at Woolhope (Herefordshire).—Dr. P. K. Ghosh: The Carnmenellis Granite: its Petrology, Metamorphism, and Tectonics.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum), at 5.30.—C. O. Becker and A. Titley: Valve Gear of the Newcomen Engine.—L. F. Loree: Josiah Hornblower and the First Steam Engine in America.
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Prof. W. Morgan: The Member and the Institution.

THURSDAY, OCTOBER 24.

FEDERAL COUNCIL FOR CHEMISTRY (at Burlington House), at 4.30.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Rev. C. Grant: Co-education.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Col. Sir T. F. Purves: Presidential Inaugural Address.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Capt. N. MacMillan: The Art of Flying Land and Sea Machines.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch), at 7.30.
ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—F. Jeans: Urological Statistics as a Criterion of Progress.
ABERNETHIAN SOCIETY (St. Bartholomew's Hospital).—Sir Leonard Rogers: Climate and Disease: Forecasting Epidemics in connexion with Smallpox, Cholera, and Plague.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—B. Martin: Steel Wing Construction.
INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—C. W. Moeth: The History of Yeast Making in Distilleries during the last Fifty Years.
INSTITUTE OF RUBBER TECHNOLOGISTS (Annual General Meeting) (at Manchester Café, Ltd., Manchester).—F. Walker: Application of Electricity in the Rubber Industry.

FRIDAY, OCTOBER 25.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—F. C. Connelly: Some Additional Lines in the Secondary Spectrum of Hydrogen.—Dr. E. G. Richardson and E. Tyler: The Transverse Velocity Gradient near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established.—B. K. Johnson: Resolving-power Tests on Microscope Objectives used with Ultra-violet Radiation.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Dislocations of the Hip-joint—Congenital and Acquired.
INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. W. H. Hatfield: The Fabrication of Acid-resisting Steel Plant (Lecture).
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Newcastle-upon-Tyne), at 6.30.—L. E. Smith: Presidential Address.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—P. C. Dewhurst and others: The Requirements of Overseas Locomotive Engineers in Respect of Locomotive Design and Details.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—The Work of the British Electrical Development Association.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. Bruff: Electric Welding as applied to Bridges and other Structures on the L. and N.E. Railway.
ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. S. P. James: Modern Aspects of the Epidemiology, Prevention, and Treatment of Malaria.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University).—Col. E. Briggs: The Chemist in Industry (Chairman's Address).

PUBLIC LECTURES.

FRIDAY, OCTOBER 18.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.—Prof. V. H. Mottram: Human Nutrition. (Succeeding Lectures on Oct. 25, Nov. 1, 8, 15, and 22.)
ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Cell Surfaces (Harben Lectures) (I.).
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Glory of Greece.
LONDON SCHOOL OF HYGIENE AND TROPICAL DISEASES, at 6.—Prof. T. J. M. Madsen: Diphtheria Toxin and Antitoxin.

SATURDAY, OCTOBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. M. Roberts: London in the Middle Ages.

MONDAY, OCTOBER 21.

UNIVERSITY COLLEGE, at 2.—A. Stratton: Houses in Tudor Times.—At 5.30.—Prof. J. Macmurray: The Philosophical Approach to Modern Social Problems. (Succeeding Lecture on Oct. 28.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Sir John Russell: Recent Field Experiments and their Lessons.

TUESDAY, OCTOBER 22.

GRESHAM COLLEGE, at 6.—A. R. Hinks: The Greater Universe. (Succeeding Lectures on Oct. 23, 24, and 25.)

WEDNESDAY, OCTOBER 23.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—J. C. Stobart: Broadcasting and Health.
KING'S COLLEGE, at 5.30.—Prof. A. W. Reed: Language and Literature (The Contribution of King's College to the Advancement of Learning during the Century 1829–1928).—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality:—The World of Empirical Experience.

THURSDAY, OCTOBER 24.

UNIVERSITY COLLEGE, at 5.—Dr. E. A. Gardner: Greece and Greek Sites (Yates Archæological Lectures). (Succeeding Lectures on Oct. 31, Nov. 7, 14, 21, 28, Dec. 5 and 12.)

FRIDAY, OCTOBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinate Biochemistry of the Cell and Tissues: The Ministers of Metabolic Change (Harben Lectures) (2).
UNIVERSITY COLLEGE, at 5.30.—C. S. Elton: The Future of Animal Ecology. (Succeeding Lectures on Nov. 1 and 8.)

SATURDAY, OCTOBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Faces and Finger Prints.

CONFERENCE.

OCTOBER 24 AND 25.

INSTITUTE OF FUEL (at Institution of Mechanical Engineers).
Thursday, Oct. 24, at 11 A.M.—Sir David Milne-Watson: Presidential Address.
At 2.—C. J. Jefferson, W. M. Whayman, H. E. Yarrow, and Dr. G. E. K. Blythe: Papers on Pulverised Fuel for Marine-type Boilers.
Friday, Oct. 25, at 10.15 A.M.—J. S. Atkinson: The Installation and Operation of Gas Producer Plants for Industrial Furnaces.—E. C. Evans: The Economics of Coke-oven Gas Utilisation in Industry.
At 2.30.—E. H. Lewis: Heat Insulation.—A. J. Dale and A. T. Green: (*a*) Fuel Control in the Ceramic Industry; (*b*) Refractories in Application to the Fuel Industries.

NATURE

SATURDAY, OCTOBER 26, 1929.

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A Parliamentary Science Committee.

THE Association of Scientific Workers has a number of achievements to its credit, but none more pregnant with possibilities for advancing the interests of science and scientific workers than its success in getting together during the last Parliamentary session more than seventy members of the House of Commons to form the nucleus of a Parliamentary Science Committee upon which it is hoped to build a body representative of both legislative houses and of all political parties. That the nucleus is so large, although less than one-third of the members of the Commons have so far been approached, is encouraging evidence of the growing desire of members of Parliament to be informed of the progress of science and the possibility of its more intensive application to the problems with which they are confronted. It was in this belief that Major Church, general secretary of the Association of Scientific Workers, and now happily once more a member of Parliament, approached them. The result justifies his belief. It is to be hoped that it will also convince scientific workers of the importance of supporting the candidature and otherwise assisting in the return to Parliament of persons who are, by virtue of their training, experience, and associations, in a position to voice their aims and aspirations faithfully and to know and evaluate the contributions which science has to make to society as a whole.

The functions of the Parliamentary Science Committee will be to accumulate and distribute to its members such information concerning the activities of scientific workers, whether engaged in industry, research, or higher educational institutions, which have bearing on Bills before Parliament at the time or on imperial problems of current interest. Periodical meetings will be held in a committee room at the Houses of Parliament, and, when desired and whenever possible, these meetings will be addressed by acknowledged leaders of scientific thought on subjects of particular interest to the Committee. For this purpose the Association of Scientific Workers has offered to act as the liaison body between the Parliamentary Committee and prominent workers in the main branches of scientific activity. That it will be able to act adequately in that capacity obviously depends on the enthusiasm of its members and the co-operation of other bodies, notably the British Science Guild and the British Association for the Advancement of Science. For some years past the British Science Guild has had a small standing Parliamentary

Committee through which it was able to bring matters bearing upon the relations between the State and science to the notice of the Government. The British Association seventy-five years ago formed a similar committee, and this committee remained in existence until 1866.

An interesting account of the activities of the first Parliamentary Science Committee is given in Mr. O. J. R. Howarth's review of the work of the British Association from 1831 to 1921. The project was first discussed at a meeting of the Council in 1850, when it was proposed to form a committee of "members of the British Association who are also members of the legislature". To quote Mr. Howarth:

"The first idea seems to have been that any person combining these two qualifications should *ipso facto* belong to the committee; but the obvious possibilities of complications arising from such a practice led the General Committee to limit the new body to selected members of both Houses of Parliament who belonged to the Association."

The committee was formed in 1854 and at first acted as the medium of communication between the Council of the Association and government authorities. Apparently Lord Wrottesley, who was also president of the Royal Society, was its first chairman—no mean asset—and it was probably due to his efforts that the representations made by the Association to the government gained in effectiveness.

During its twelve years' existence this Parliamentary Committee appears to have brought a number of very important matters to the notice of government and achieved no inconsiderable measure of success. In 1854 it stimulated the Board of Trade "to improve conditions and facilities for navigation, and for accumulating marine meteorological data on a large scale": it made representations on the principles governing the award of Civil List pensions in relation to scientific workers, and the allocation of accommodation for scientific societies in Burlington House in order to bring such societies into closer juxtaposition. The following year it produced a document dealing with the measures which should "be adopted by the Government or Parliament to improve the position of science or its cultivators in this country" (including reforms at those universities "which do not at present exact a certain proficiency in physical science as a condition preliminary to obtaining a degree" and the creation of a Board of Science). In 1857 it asked for the publication of the results of the trials of steamships employed in the public service, and the sending of an annual expedition to the Niger. A request for increased accommodation and staff for the Meteorological Department of the Board of Trade, an application for an expedition to be sent to the Mackenzie River (northern Canada) and for the dispatch of an expedition under Livingstone to the Zambezi River, were made in 1858. That year also, although apparently without official support from the Association, the Parliamentary Committee referred to the "proposed severance from the British Museum of its Natural History Collections" as calculated to inflict a deep injury to science.

In 1859, Admiral Fitzroy was authorised to proceed in bringing to a practical issue the recommendations made to the scientific department of the Board of Trade on the subject of telegraphic communication between seaports of the British Isles. The same year the Parliamentary Committee was successful in obtaining government support for the dispatch of another African expedition, that under Speke and Grant, for the exploration of Victoria Nyanza and Uganda. Most noteworthy and fruitful in results was the action taken by the Parliamentary Committee in 1865 in arranging for Sharpey, Miller, Huxley, and Tyndall to give evidence, during the select committee stage of the Public Schools Bill, on the extent to which physical science might be introduced into the curriculum of the great public schools. "The bill did not pass," says Mr. Howarth, "but public interest was to some extent awakened, and it is recorded that voluntary efforts were made by masters at certain schools to add instruction in natural science to the classical course, while 'some of the boys at Harrow . . . formed themselves into a voluntary association for the pursuit of science'."

In spite of the varied nature of its interests and the obvious success which attended its efforts to secure greater recognition for science, this first Parliamentary Science Committee did not survive the death of its chairman, Lord Wrottesley, in 1867. This by no means implies that the Association ceased to bring pressure to bear on government to further the Association's aims. It continued to do so, and not without effect, but it is doubtful whether members of the legislature maintained the same lively interest in the recommendations of the parliament of science. This lack of interest may have been of immediate advantage to science. On the other hand, the removal of the subject from the sphere of Parliamentary controversy almost inevitably had the effect of diminishing public interest, just at a time when science was dependent

on a quickened public interest for the consolidation of the position it had occupied in face of the opposition of the protagonists of the classics and dogmatic theology, the representatives of which were still strongly entrenched in Parliament.

The revival of the Parliamentary Science Committee immediately provokes speculation regarding its possible interpretation of its functions. There is certainly no dearth of material to engage its attention. The present government, like the last, gives it plenty of scope for the exercise of its powers of destructive criticism. This government, in spite of the lip-service paid to science by the party it represents, has shown not the least disposition to give scientific workers effective representation on the important development committees it has set up. Neither the advisory committee which Mr. Thomas has appointed for considering industrial development in Britain, nor the committee he has appointed for considering colonial development, is calculated to inspire scientific workers with confidence in their capacity to appreciate the contributions which science can make to either problem. The same criticism, but with even greater emphasis, can be levelled against the constitution of the Royal Commission on the Civil Service, promised by Mr. Baldwin and appointed by Mr. MacDonald. The committee recently set up to consider the preservation and creation of National Parks contains no naturalist, a stupid omission. Lord Passfield, in reconstituting the Empire Marketing Board consequent upon the change of government, has not appointed an accredited representative of science either on the main body or, what is still more surprising and unsatisfactory, on its Research Grants Committee. Mr. Clynes presumably expects the Licensing Committee which he has appointed to report on the alcoholic drink question to consider the effect of alcohol on the body and mind. Drinking to excess is manifestly harmful, but it does not necessarily follow that drinking in moderation is not beneficial. The appointment of a physiologist with expert knowledge of the effect of alcohol on our metabolism might have lent authority to the final pronouncements of the committee.

It is to be hoped, however, that the Parliamentary Science Committee will not be expected to spend its time framing and passing resolutions protesting against this or that act of government. The tendency on the part of governments to overlook the need for science to be represented on government committees of various kinds set up for considering problems, to the solution of which scientific workers can make valuable contributions, is largely due to the fact that scientific workers themselves have not pointed out what contributions they have to make to the subjects under consideration. Where they have brought pressure upon the government, as in the case of the revision of the Patent Laws, the government has proved amenable.

Scientific workers should make use of the Parliamentary Science Committee to bring to the notice of members of Parliament what science has done, is doing, and can do, and what they expect governments to do to encourage scientific research. The encouragement of scientific research is not a matter about which the electorate can be stirred to any great enthusiasm. Science is essentially a non-controversial subject: Parliament rarely discusses, and Ministers rarely refer to, the activities of the research workers attached to the departments for which they are responsible. Expenditure on research is rarely challenged. This absence of publicity is neither to the advantage of scientific workers nor to the progress of scientific research.

It is high time that members of Parliament were better acquainted with the work of departments to which they vote fairly large sums of public moneys yearly. They should know something about the activities of the Medical Research Council, the Empire Marketing Board, the Development Commission, the Department of Scientific and Industrial Research, the University Grants Committee, and the research departments attached to the three fighting services. These bodies are responsible for the encouragement of research over fields covering the industrial and social life of our peoples at home and overseas. Much of the work done and in commission has a definite bearing upon matters before the Imperial Parliament. Members of Parliament do not yet appreciate this fact, not because they are obscurantists or unwilling to be instructed, but because no systematic efforts have been made to instruct them. Most of the above-named departments issue periodical reports, and these are supplied gratis to any member of Parliament who troubles to ask for them. That few do so is the fault of scientific workers rather than that of our legislators. Scientific workers have not yet succeeded in organising themselves into a professional body possessing political significance by reason of its representative character. Such an organisation is necessary if the Parliamentary Science Committee is to become a really effective body.

Petroleum Geology.

(1) *Earth Flexures; their Geometry and their Representation and Analysis in Geological Section, with special reference to the Problem of Oil Finding.* By H. G. Busk. (Cambridge Geological Series.) Pp. vii + 106. (Cambridge: At the University Press, 1929.) 12*s.* 6*d.* net.

(2) *The Geology of Petroleum and Natural Gas.* By Prof. E. R. Lilley. Pp. x + 524. (London: Chapman and Hall, Ltd., 1928.) 30*s.* net.

(3) *Analytical Principles of the Production of Oil, Gas and Water from Wells: a Treatise based upon a System of Fluid Mechanics particularly adapted to the Study of the Performance of Natural Reservoirs.* By Dr. Stanley C. Herold. With a Foreword by Cyrus F. Tolman and a Final Summary by Ernest K. Parks. Pp. xi + 659. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1928.) 35*s.* net.

(1) IF it be a geological axiom that outcrop evidence is not necessarily indicative of subsurface structure, which is admittedly true in many cases, that where comparatively soft rocks are involved the divorce between the two may be so great as to render one an unreliable guide to the other, then it is easy to find many flaws in Mr. Busk's thesis. We cannot help feeling that rather special cases have been chosen as the basis of the hypotheses, constructions, and proofs composing this geometrical geology; that were the methods faithfully applied to the rocks of Trinidad, Venezuela, or southern California, for example, where surface data are often misleading or scanty, in contrast to the almost overwhelming evidence of the naked rocks of Burma, Egypt, and Persia chosen as the basis of discussion, some grotesque interpretations of underground conditions could result; certainly the limits of error in locating oil-pools involved could scarcely be said to be narrowed in such circumstances. On the other hand, there is something to be said for the purely geometrical treatment of folding, especially for those to whom the third dimension is elusive, even if it only teaches precision in thought and expression. In these matters geology has need of all the mathematics it can legitimately absorb, though we may be devoutly thankful that the science can never be reduced to a string of uninspiring formulæ: even inexactitude is a blessing sometimes.

The theme of this work is that exactitude of graphical expression of earth flexures is attained by employing tangential circular arcs having normals to measured surface dips of the rocks as radii; in other words, that geometrical conics should displace methods in which curves are reduced to straight lines at right angles to the normals of known dips, a procedure which was expounded some years ago by Sir Thomas Holland and has been widely followed in professional work in the Eurasian oilfields.

Anything is better than sketch-sections or those terrible essays in 'geological artistry' which are the delight of certain draughtsmen to be found all the world over. At all events, given the conditions visualised by the author of this book, there is a good case for following his precepts. To whatever extent we may differ from him in his Euclidean attempt to bring law and order into subsurface geological studies, we have to admire the sincerity of his appeal for greater precision, as we heartily endorse it, and at the same time welcome this work on account of its refreshing originality. But we close the book with a reflection, possibly a faint sigh of relief, that even Mr. Busk's masterly translation of earth flexures into geometry has not been able to deprive the former of the glamour of that glorious uncertainty which is the very lodestone of the science.

(2) How different is Prof. Lilley's book. Had we read it before "Earth Flexures", possibly the contrast would not have been so vivid. Compilation and recapitulation are two words which should long ago have been allowed to pass out of the petroleum technologist's vocabulary, especially if he aspire to authorship. Yet in this latest geology of petroleum, it is not easy to find much to which one or the other does not apply. Those who are familiar with the literature will also recognise many old friends, some of them indeed well-tried, among the many illustrations scattered throughout the book.

However, as the avowed purpose of the author is to provide individuals who cannot keep pace with the mass of technical publications with "a single volume in which they may find brief statements of the principles of the science and examples illustrative of the application of those principles", we can scarcely blame him for sticking to his last. In one respect his treatment of the subject is superior to many former attempts of others: instead of discussing the geology of the important oilfields of the world country by country, he takes as his basis the different structural conditions under which oil can and does occur, and selects as illustrative examples those fields which are relevant. The

selection on the whole is good, though, as might be expected, American fields figure rather to the exclusion of foreign developments which in some cases could provide even better illustration than those chosen.

The last chapter on exploration of new areas breaks away from monotony of description and reviews possibilities ranging from the significance of surface-indications of oil to the pros and cons of geophysical prospecting and, be it noted, the 'limitation of geologic activity'; here was a chance for the author to let his imagination guide his pen, but it was not taken. That, we believe, is the whole trouble with works of this description: the compiler is so buried in the mass of material at his disposal, so deluged with facts and theories which must find a place in a text-book, that there is little or no opportunity for personal expression, for just that touch of ego and occasional glimpse of imagination which animate even the most ponderous subject. This leads us to another recent volume.

(3) Few will deny that "a treatise based upon a system of fluid mechanics particularly adapted to the study of the performance of natural reservoirs" is, on the face of it, a weighty subject for discourse. In Dr. Herold's work it takes a heavy book of well over six hundred pages to deal with this most important branch of oil and gas production, and it is doubtful if one of those pages is superfluous. We have here undoubtedly the most valuable and original contribution to our knowledge of the fundamental principles underlying the production of fluids from wells.

The thesis is developed gradually from an exposition of those laws of physics and properties of matter which are relevant to the conception of fluid reservoirs and of the behaviour of such fluids under varying natural conditions. The author contends that there are three great classes of reservoirs to one of which every oil, gas, and water well must belong. Control of the fluids involved is thus vested in three factors, hydraulic, volumetric, and capillary. The detailed mathematical and physical analyses of each of these controls constitute the essential part of this treatise; such analyses proceed uniformly by consideration of ideal performance and its primary and secondary functions.

The work as a whole is necessarily one of reference, and as such will serve as a standard for a long time to come. The temptation to swamp his hypotheses and proofs in a whirlpool of higher mathematics has been nobly resisted by the author, who has, in point of fact, shown considerable restraint in this connexion. This does not imply that his ideas lack precision or that pure description has been allowed to displace theorem; on the contrary, the necessary functions are always clearly stated, and where mathematical expression is due, it is not stinted; at the same time, it is never abstruse.

This book is full of originality tempered with a well-curbed imagination. It will, of course, find its deserved niche on every production engineer's bookshelf; it should also be noticed by all concerned with the teaching or application of the principles of fluid mechanics; none should lay it down, however, without reading the preface, which gives us a pleasing insight into the mind of a modest and erudite man, and also Mr. Parks's summary of the author's analysis, especially as his conceptions affect the oil and gas industry.

What is Sociology?

An Introduction to the Study of Society: an Outline of Primary Factors and Fundamental Institutions. By Prof. Frank Hamilton Hankins. Pp. xiv + 760. (New York: The Macmillan Co., 1928.) 17*s.* net.

PROF. HANKINS holds the chair of sociology at Smith College. He has written a book which suggests two questions. Is the task which he has undertaken one which falls to the sociologist as such to accomplish? Is he following the best method to achieve the purpose which he has in view? The title and sub-title of the book give some idea of its scope. It includes discussions of the origin of man, the races of man, the physiographic, biological, psychological, and cultural factors in social life, the evolution of material culture, myth, magic, religion, and science, marriage and the family, and ends with an examination of social organisation and integration. It may be said at once that this is an exceedingly competent production. The author has patiently mastered a huge mass of material; he exhibits good judgment and width of mind. The exposition is orderly and lucid. The book is what it purports to be—a scientific study of the background of social life.

The book is intended to serve as a text-book for a general introductory course. Assuming such a course to be desirable, a matter which deserves discussion, does it properly fall to the department of sociology to undertake it and to the head of the department to supply the text-book? This is not a mere question of academic organisation. At

present there is no general agreement as to what constitutes the province of sociology, and the work assigned to, and undertaken by, these departments may affect the whole future of sociology. When we find them engaged upon these synthetic tasks, we recognise the old tradition that sociology is in some sense a super-science. We realise also the weaknesses of this definition. However necessary the task, however admirably carried out, as in this case, it is not possible to find in synthetic work of this kind the sphere for a special science. In practice, it generally comes to retailing at second hand the results of various social sciences. Matters are not substantially improved by supposing that the true function of sociology is to be found in the interpretation and correlation of these other studies. There is ample scope here—but this work cannot be deliberately undertaken and made the subject of everyday research. We must wait upon the appearance of the exceptional man, usually a notable contributor to some existing social science, who oversteps its frontiers and forges links with cognate studies.

Thus we come to the well-worn discussion as to whether there is any special field which can be said to be that of sociology. We can begin by agreeing that, if sociology is a science, social philosophy and social ethics, however deeply concerned any sociologist worthy of the name is bound to be with this range of problems, lie without its field. At that point disagreements appear. But opinion seems to be hardening in the direction of admitting that there are two quite distinct fields of investigation, either of which might claim the title of sociology. The first includes an apparently somewhat ill-defined group of data which do not fall within the fields of political science or of economics, however widely the latter may be extended under the guise of social economics. These data relate to the family, social organisation, and modes of living. They are as susceptible of quantitative treatment as are economic data. The second is less obvious. But there is a good case for the view that human relations and interactions provide a special field of study. There is something common to economics, political science, and the other existing social sciences which is missed by each of them. This something is the interaction of human beings, whatever the cause, result, and content of these relations may be. Existing social sciences deal mostly with the content of relationships. The mechanism of interaction, which is common to them all, escapes scientific study. Little progress, however, has yet been made in this direction.

There are perhaps other possibilities. The matter cannot be discussed here. It is relevant for one reason only. Nothing is more certain than that there is no place in the academic organisation of teaching and research for departments which only deal at second hand with the results obtained elsewhere, however loudly they may claim to be concerned with 'interpretations' and 'syntheses'. If sociology is to survive, to say nothing of progressing, general agreement must be reached regarding its special field, and on this account we may regret, however much we may admire his work itself, that Prof. Hankins should seem, because he does his work as a sociologist in a sociological department, to be putting back the clock.

The second broad question suggested by the book deserves some consideration. The book is intended to serve as the basis of a general introductory course for students in their sophomore or even in their freshman year. Such courses are becoming common in the United States. Teachers in American universities are perplexed by the lack of background shown by their students and are endeavouring to fill it in. They adopt the method of direct attack. But is this the best way to do it—at least under our conditions? It may very well be that different social and intellectual traditions and atmospheres demand different educational methods and that the Americans diagnose their own problems correctly when they design such courses. To us in Great Britain it may seem that there is danger that these courses will fail to achieve the two chief aims of education, to light up the imagination and to teach people to think. The imagination may be dulled rather than fired by the absorption of masses of varied knowledge, and there can be little stimulus to think when, owing to the vast range of the subjects touched upon, the boundaries of the known are never reached and there is no time for the making of generalisations step by step after an adequate examination of the data.

If we in Great Britain can be said to adopt any method at all, it is an indirect one. We hope that specialist students, taught to think in their own field and intellectually alive, because they have somewhere come up against the boundaries of knowledge, will extend their interests and broaden their outlook. But at its best this works only with good students. Surely something more could be done deliberately for the mass of our students without reversing our methods. If the specialist student of a pure science could be encouraged to take an interest in its history on one hand and in the

philosophical criticism of its assumptions on the other, he would be progressing out of specialism into humanism. But deliberate planning is necessary, and this is lacking. We may not altogether like the American plan, but we have no organised alternative to offer.

Elementary Botany.

(1) *A Textbook of General Botany.* By Gilbert M. Smith, James B. Overton, Edward M. Gilbert, Rollin H. Denniston, George S. Bryan, and Charles E. Allen. Revised edition. Pp. x + 539. (New York : The Macmillan Co., 1928.) 16*s.* net.

(2) *A Laboratory Manual of General Botany.* By Emma L. Fisk and Ruth M. Addoms. Pp. ix + 103. (New York : The Macmillan Co., 1928.) 4*s.* 6*d.*

(1) THE growing tendency towards co-operation is shown by the increasing number of works that are published under joint authorship, but it is unusual to find an elementary text in which so many authors have collaborated as that before us. It is therefore with some curiosity that we peruse this experiment in multiple collaboration, for which all six authors would appear to have been collectively and severally responsible. If on one hand we are reminded of the proverbial benefits accruing from a multitude of council, on the other we recall that the broth of wisdom may suffer in homogeneity from too many compositors.

The plan of the book exhibits an especial emphasis upon the plant groups, the treatment of which occupies some 230 pages of text. By describing a larger number of types of cryptogams than are commonly exemplified in works of this standard, the reader gains a more adequate concept of the groups represented. This, however, is accomplished at the expense of the other and, from an educational point of view, probably more valuable aspects of the subject.

The families of flowering plants are treated only as part of the chapter on floral types, which contains descriptions of nineteen selected families of phanerogams. The descriptions are, however, so superficial that the reader who relied on these alone for guidance might justifiably assume that the fruits of all Ranunculaceæ were achenes, that all Cruciferous flowers possessed six stamens, and that in all Leguminosæ a single free stamen is present.

Some of the physiological matter is simply if all too briefly presented, but the explanation of the principles of diffusion of water vapour and other gases from the chlorenchyma leaves much to be desired. When we turn from the text to the figures we find even more evidence of insufficient care and thought. No subject is perhaps more commonly misunderstood by elementary students than the phenomenon of secondary thickening, which authors should therefore treat with meticulous accuracy and clarity. Here, not only is the description meagre, but also the figure which is intended to elucidate this portion of the text shows a longitudinal section of a root in which the youngest portion near the apex contains only secondary wood of the third year, whilst the second-year wood and the first-year wood are confined to the older regions ; an error that is fundamental and not one of mere inaccuracy of lettering. Again, the figure of the elm twig entirely ignores the essential feature of the branching in this species. These are merely a few of the many shortcomings that a perusal of these pages reveals.

The concept of an elementary text depends for its success not merely upon the accuracy of the information conveyed, or upon the amount of knowledge which it imparts, but also upon the educational aim which that knowledge serves and the subjective judgment of the authors in its selection. It would be manifestly unfair to regard the present work as evidence against the value of co-operation, but having regard to the fact that this is a " revised edition ", it is impossible not to surmise that the text would have been clearer and the errors fewer if the individual responsibility had been greater.

(2) The laboratory manual serves as a guide to the practical work which it is suggested should accompany the use of the text-book just considered. The work is divided into thirty-six exercises, of which eighteen are occupied with the study of types, five with the angiosperms, and the remaining thirteen with anatomy, morphology, and physiology. The undue emphasis upon the study of plant groups is again indicated by these proportions. The inadequacy of the anatomical work suggested is sufficiently exemplified by the treatment of secondary wood, where the only drawing which the student is asked for is a ' diagram ' of a cross-section. There is no exercise in the use of microchemical tests, neither are instructions given for the use of stains and reagents for the differentiation of tissues, whilst the practical work on respiration consists of sketching a demonstration apparatus, and experiments on transpiration are ignored.

One cannot but deplore the increasing number of elementary texts that add nothing helpful either in substance or in method to botanical teaching and, at least in their own provenance, may replace texts that are real aids to the student in his difficulties. E. J. S.

Marriage.

Ideal Marriage: its Physiology and Technique. By Dr. Th. H. Van de Velde. Translated by Stella Browne. Pp. xxvi + 323 + 8 plates. (London: William Heinemann (Medical Books), Ltd., 1928.) 25*s.* net.

THIS compact book, written by the some-time director of the gynæcological clinic at Haarlem, a psychologist, and a connoisseur of human nature, gives, as its sub-title indicates, an introduction into the art of conducting an ideal marriage. It approaches its subject from the physiological side mainly, but it is based on an essentially sound sociological conception of matrimony.

Nowadays, when the institution of marriage is being the subject of much discussion and some reform—revolutionary as in Russia, somewhat hysterical as in the United States, and perhaps almost too slow as in Great Britain—this book will be of interest not only to those who read it as a practical guide, but also to students of human society and human nature.

In the first part, after a succinct but comprehensive introduction discussing the real nature of marriage, the author gives a detailed analysis of the physiology of reproduction. The second part deals with more specific questions of anatomy and function. The third part is an outspoken, but in no way pornographic, analysis of technique in marital relations. In the last part, Dr. Van de Velde gives advice as to the mental and physical hygiene of the personal relations between married people.

The book raises, of course, the question how far it is possible to deal scientifically with what might be called the most subtle and most intimate technique of human relations. The present work gives us the reflections, conclusions, and the philosophy of a man with wide experience, with a great deal of common sense, and a capacity for plain but clean speaking, and it justifies itself as a manual of conduct, if not as a scientific disquisition. Treated as a document, it is really valuable for the sociologist, the student of human culture and of the human mind.

This brings us to the second question: such a book could obviously not be sold in the open bookselling market; the publishers have limited its sale strictly to the medical profession. This certainly is not in any way justifiable: there should be some provision by which a man of science, whether he be a biologist interested in reproduction, or a psychologist studying problems of sex, or a sociologist, should have as easy an access to such a book as the average medical practitioner. The neglect and even scorn of science and of scientific status, so characteristic of public opinion and official attitude in Great Britain, is exemplified nowhere so clearly as in the silly and irksome discrimination which is given to the 'medical and legal professions' and neglects completely the researcher and the academic teacher; and gives him no place above the man in the street or the seeker after pornography.

B. M.

Our Bookshelf.

Anatomy and the Problem of Behaviour. By G. E. Coghill. (Lectures delivered at University College, London.) Pp. xii + 113. (Cambridge: At the University Press, 1929.) 7*s.* 6*d.* net.

THE anatomy into which behaviour does not enter, at least unconsciously, is generally regarded as an academic study incapable of formulating general conclusions and therefore sterile. The anatomical method which has proved most valuable in the hands of British investigators is that which seeks to establish a comparative correlation between structure and function. It is therefore hard to understand why the same method which has proved so suggestive in comparative anatomy has not been pursued more vigorously by embryologists, in order to elucidate the meaning of neurological structures, since this method is even more accessible to professed zoologists than to human anatomists in England. Dr. Coghill, the author of these three lectures, is a member of the Wistar Institute of Anatomy and Biology at Philadelphia; but the lectures were delivered in London. He has made a parallel study of the development of behaviour and of the nervous system of *Amblystoma* with signal success for his purpose.

We should expect behaviour to develop consistently with the order of development of the nervous system. The demonstration that it does so is therefore of less general interest than, for example, Dr. Coghill's observation that the muscles which move the gills of *Amblystoma* act at first with the trunk muscles although they are under the nervous control of different centres. The reason assigned is that until appropriate sensory connexions are established for local reflexes, the motor pathway to the trunk actuates the gill nerves and their muscles. There is thus evidence for the existence of an early, more generalised anatomical pattern which acquires discreteness anatomically and physiologically. "The development of behaviour primarily through the extension of the total pattern rather than through the projection of primarily isolated parts to become integrated secondarily, means that the maintenance of the integrity of the individual as a whole is the elementary function of the nervous system." However complex the organisation, conduction alone cannot fully account for the rôle of the nervous system. Its own growth is one of the conditions of

its functioning, and this is not dependent upon exercise or intensified function in those parts of the nervous system in which it occurs, as was supposed by those who wrote before adequate data concerning the correlations between the growth processes and behaviour became available. Such is the argument in brief outline. It will be seen that it depends not only upon accurate observation of behaviour but also on trustworthy evidence concerning the anatomical mechanisms involved. The behaviour is the easier to observe. Are we sure that the histology which is so fast becoming a convention is beyond reproach?

Die Entstehung der Kontinente und Ozeane. Von Prof. Dr. Alfred Wegener. (Die Wissenschaft, herausgegeben von Prof. Dr. Wilhelm Westphal, Band 66.) Vierte umgearbeitete Auflage. Pp. x+231. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 10 gold marks.

The fourth edition of Wegener's "Entstehung der Kontinente und Ozeane" is greatly enlarged and improved. For example, of the previous illustrations 12 are omitted, but the total number is increased from 44 to 63. The author naturally directs attention to the widespread new support to his hypothesis, especially among meteorologists and physicists, and its adoption by some geologists such as Argand, Staub, and Matley. He mentions some recent criticisms, as in the symposium arranged by the American Institute of Petroleum Geologists, but fails to meet the arguments there put forward.

The new edition directs attention to the seismic work on the rate of earthquake waves under the Pacific. In an appendix in support of the view that longitude determinations prove the westward drift of America, though the author reduces his estimate for the annual increase in the distance between Washington and Paris to a third of a metre, he claims this amount on the basis of longitude observations in the years 1913 and 1927. These results, however, are inconsistent with those given by longitude determinations between Washington and Greenwich in 1913 and 1926. According to Sir Frank Dyson, they show a total decrease in the distance of 30 ft. instead of the reported annual increase of one foot. The author does not notice some of the later work in criticism of the longitude determinations upon which he claimed the rapid westward drift of Greenland. One of the new illustrations deals with the mode of formation of the island festoons of the western Pacific, but it does not seem to represent the actual geological conditions.

The one serious defect in the new edition is the omission of the index, which is especially inconvenient owing to the rearrangement of the book, and the consequent trouble to those who wish to see what modifications have been made in sections of the discussion that specially interest them.

The Journal of the Institute of Metals, Vol. 41. Edited by G. Shaw Scott. Pp. xii+825+42 plates. (London: Institute of Metals, 1929.) 31*s.* 6*d.* net.

In the course of its twenty-one years of existence the Institute of Metals has rendered great services to the science of metallurgy, and has been the means of encouraging research into many metallurgical problems. Its latest volume contains a number of valuable papers. Sir Oliver Lodge's May lecture will be read with interest, consisting as it does of personal reminiscences of scientific discovery in connexion with the electrical and magnetic properties of metals, with suggestive speculations as to the nature of their underlying causes. Good work is being done in Great Britain in the difficult but important field of the establishment of equilibrium diagrams for alloy systems, and the systems magnesium-zinc and cadmium-gold have been added to those which have been studied in the light of modern ideas as to equilibrium in solids, whilst the volume also includes a further study of the age-hardening of certain aluminium alloys, a phenomenon of technical importance which has now been shown to be much more general than had been supposed.

The international character of the Institute is illustrated by a paper on eutectics by Prof. Saldau of Leningrad, and there are several communications dealing with matters of practical and industrial interest. A report which is of value to physicists as well as to metallurgists is that by Miss Elam on the results so far obtained in the study of alloys by means of X-rays. This is a most useful compilation, which will save much labour in searching for references. The abstracts, which form a large portion of the volume, are another valuable feature.

Practical Color Photography. By E. J. Wall. Pp. vii+280. (London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

Amateur Cinematography. By Capt. Owen Wheeler. Pp. xi+135. (London: Sir Isaac Pitman and Sons, Ltd.; Henry Greenwood and Co., Ltd., 1929.) 6*s.* net.

Heraclitus: or the Future of the Films. By Ernest Betts. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s.* 6*d.* net.

There are some subjects nicely compounded of general and particular interest, such, for example, as photography. In this, too, where amateurs frequently excel, not a few professionals fail from the artistic point of view. The three recent books on this art referred to above merit attention. Mr. Wall evinces a mastery of his subject, though it lacks presentation in a pleasing form; the trees hide the forest. His reference to juxtaposition of colours in preference to superposition is deserving of attention. Capt. Wheeler provides a most attractive book, and it is amusing to read his and Mr. Betts's references to the 'some-day' appearance of the talkie film. Capt. Wheeler regards it as "long distant"; Mr. Betts hopes it will be long distant; it has arrived, however, rather prematurely. Mr. Betts's subject is, *par excellence*, the future of the film, and with it he pictures the combination of television for political propaganda. "Elections may yet be won on good looks rather than fine words, and no doubt we shall be quite as well off." P. L. M.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electrical Excitation and the Possible Structure of the Plasmatic Membrane.

BANCROFT'S observation that the oil in oil-water emulsions tends to become the continuous phase in the presence of calcium salts and the discontinuous phase in the presence of sodium salts was developed by Clowes (*Jour. Biol. Chem.*, vol. 24, p. xiv; 1916) into a physical explanation of the phenomenon of the action of antagonistic ions on the permeability of cell membranes.

Bancroft showed that when the molar concentration ratio of sodium to calcium was about 98 : 2 there was an equalisation of the surface tensions of the two phases : when the ratio is greater, the surface tension of the oil phase is the greater, and it becomes the disperse phase; and, conversely, it becomes the continuous phase when the [Na] : [Ca] ratio is smaller.

Those salts which promote the dispersion of oil in water (sodium, etc.) also bring about an increase in the permeability of cell membranes, and this permeability effect is antagonised by the presence of salts which promote dispersion of water in oil; moreover, Clowes showed that the ratio of concentrations of various mixtures of salts at the inversion point of oil-water emulsions is the same as that at which their antagonistic action on cell permeability is most pronounced. These facts suggested that the plasmatic membrane might be an oil-water emulsion. In its water-in-oil state it would be impermeable to ions, etc., but permeable to lipoid-soluble substances, as Overton and others have found in certain cases with cell membranes. On inversion to the oil-in-water state these permeability relations would be reversed; this reversed condition is largely observed.

The object of this present preliminary communication is to direct attention to the striking similarity between the electrical excitability of such emulsions and of living tissues.

Two stock emulsions were prepared by grinding together the following ingredients : (1) 'Sodium emulsion', olive oil 50 c.c., water 25 c.c., oleic acid 1 c.c., NaOH 0·08 gm.; (2) 'Calcium emulsion', exactly similar except that 3·0 gm. CaO were used instead of 0·08 gm. soda.

The specific conductivities of a series of mixtures of these two emulsions were as follows :

Na emulsion .	10	8·4	7·2	6·3	5·5	0·0
Ca emulsion .	0	1·6	2·8	3·7	4·5	10·0
Spec. Res. in ohms × 100 .	20·5	18·4	inf.	inf.	inf.	inf.

Clearly those mixtures containing less than 28 parts per 100 of the calcium emulsion stock are freely permeable to ions and are thus of the oil-in-water type.

The mixture of 2·8 parts of calcium stock to 7·2 parts of sodium stock was then placed in the conductivity cell with electrodes 2·5 mm. apart and was stimulated by application of an alternating current of 200 volts, 50 cycles, for 2 seconds. The resistance at once fell from the initial value of more than 50 megohms (inf.) to 240,000 ohms, and continued to fall for about 10 minutes after the stimulus, attaining the minimum value of 195,000 ohms.

From this point the resistance began to increase, and in about 4 hours it had recovered to the value of one megohm, and 17 hours later it was again infinite.

Living tissues also possess a very high resistance which may fall to as little as 2 per cent of its original value when the tissue is subjected to a suitable electric stimulus (Dixon and Bennet-Clark, *Proc. Roy. Dublin Soc.*, vol. 18, No. 29; 1927; and *Notes from Bot. Sch. Trin. Coll. Dublin*, **4**, p. 33). The minimum value of the resistance of a tissue after stimulation is also attained some minutes after the stimulus, and from this the resistance also starts to rise again.

This remarkable behaviour of the oil-water emulsions on stimulation represents the closest parallel yet found in an artificial system to that found in the living protoplasmic membranes.

This change of conductivity of an emulsion is only brought about by relatively small stimuli when its composition is such that it is close to its inversion point.

That the effect of the stimulating current is to invert the emulsion is clearly seen when thin films of emulsion are watched under a microscope at the moment of stimulation. Immediately the stimulating current is started the water drops distributed through the oil instantaneously run together, and water areas filled with oil drops appear where previously separate drops of water were dispersed. The phenomenon is more clearly seen when the water is coloured with phenol-phthaleïn.

One explanation of the phenomenon which suggests itself is that the running together of the water drops is due to a reduction of their surface tension, and, as this becomes less than that of the oil phase, inversion of the emulsion takes place.

Such a decrease of surface tension will almost certainly take place if a current of sufficient voltage is applied across the emulsion, as ions and soap micellæ will be banked against the impermeable sides of the water drops, and this increase in concentration will cause a change of surface tension.

Such an increase in the concentration of ions at impermeable membranes in the tissue to a certain limiting value is the condition postulated by Nernst and Hill for the excitation of nerve and muscle.

From this postulate have been deduced the relationships between voltage and frequency of the liminal alternating current, and between voltage and duration of the liminal direct current which will excite a given tissue. These relationships have been verified experimentally in nerve and muscle (see Keith Lucas, *J. Physiol.*, **40**, p. 225; 1910).

The hypothesis that the limiting layer of the plasmatic membrane is an oil-water emulsion at its inversion point would explain how this rise in concentration of ions at the membranes actually brings about excitation. The additional hypothesis is included that the membranes in question are the surfaces of the water drops of the emulsion.

Experiments on emulsions, shortly to be published, show that the relation between the voltage applied to a given emulsion and the response evoked (that is, the change in resistance) is of the same type as that obtained from living tissues; in the former case there is a simple physical explanation of the quantitative results which may possibly also apply to the living tissue.

Moreover, it is also shown that the minimum D.C. voltage required to bring about a change in the resistance of an emulsion is related to the time for which it is applied in the same way as that deduced for the conditions postulated above. In one experiment where the simple relation, $i\sqrt{t} = \text{constant}$, was tested,

the values obtained were 226, 245, 249, and 237; when i is expressed in volts and t in hundredths of a second.

It has also been shown that addition of sodium salts increases the sensitivity, and it seems clear that this effect is produced by bringing the emulsion closer to the inversion point. In these circumstances the required increase in concentration of ions for excitation will be less.

In summary and conclusion, it may be said that the hypothesis that the plasmatic layer of the living cell is a water-in-oil emulsion close to its inversion point correlates and gives relatively simple physical explanations to the following diverse phenomena:

Effects of antagonistic ions and narcotics on permeability.

Effects of electric currents on permeability.

The Nernst theory of excitation.

The effect of calcium on excitability of nerve and muscle.

Henry H. Dixon.
T. A. Bennet-Clark.

School of Botany,
Trinity College, Dublin,
Oct. 4.

Photosensitised Decomposition of Ozone.

During the last twelve months we have been working on the photodecomposition of ozone sensitised for visible and long-wave ultra-violet light by the addition of chlorine. A detailed analysis of the somewhat complex pressure changes which occur on insolating or on cutting off the light from a mixture of these gases kept at constant volume, combined with quantum efficiency measurements under various conditions, caused us to suspect the formation, during the course of the reaction, of small amounts of an intermediate compound, and this view has been strikingly confirmed by some recent observations.

The first was that the transmission for the mercury 365 $\mu\mu$ line of an ozone-chlorine mixture containing low concentrations of chlorine increases appreciably during the early stages of the reaction.

The second was that, using sulphuric-acid dried gases, a distinct mist is formed in the gaseous mixture on insolation. Further experiments have shown that this mist is less pronounced under more stringent conditions of drying, and that the resulting trace of liquid, when dissolved in water, (*a*) gives a positive chloride reaction with silver nitrate solution after boiling with ferrous sulphate and sulphuric acid (both the original solution and the reagents were free from chloride), and (*b*) gives potassium perchlorate, recognised by its characteristic crystalline form, on treatment with a drop of concentrated potassium chloride solution, and also gives a positive crystalline perchlorate reaction with brucine.

Finally, we have shown that, if chlorine dioxide, dried by phosphorus pentoxide, is mixed with dry ozone, a red liquid is produced. On admitting moist air, an immediate mist is observed and the liquid is hydrolysed with formation of chloric and perchloric acids.

These observations are consistent with the view that, during the reaction, the following processes take place: (i) Production of Cl atoms by light; (ii) formation of ClO_3 groups by union of Cl atoms and O_3 molecules; (iii) a short chain reaction, probably terminated by adsorption of intermediate atoms or groups on the walls; (iv) union of a certain number of ClO_3 groups to form the chlorine hexoxide of Bodenstein, Harteck, and Padelt (1925), this immediately hydrating in presence of traces of moisture to form chloric and perchloric acids; (v) formation from Cl atoms and O_2 molecules of ClO_2 molecules, these reacting with O_3 molecules to give ClO_3 groups and O_2 molecules.

A. J. Allmand.
J. W. T. Spinks.

Chemical Department,
King's College,
London, W.C.2, Oct. 10.

An Absolute Method of Measuring High Frequency Currents.

Until recently the measurement of currents at radio-frequencies has depended on the assumption that the instruments used did not alter their calibration with frequency, and every endeavour was made to satisfy this condition. The method largely adopted comprised the use of sufficiently thin conductors so that freedom from skin effect could be obtained. While this naturally limited the magnitude of the currents which could be employed satisfactorily, transformer and condenser methods have been used by D. W. Dye and P. R. Coursey respectively at medium radio-frequencies, for the conversion of large currents into those which could more conveniently be measured directly. More recently, E. B. Moullin has developed an instrument the operation of which depends upon the attraction of two parallel wires carrying the same current. While this instrument would appear to be satisfactory as an absolute method of measurement, it has been considered desirable to develop another method based upon a different principle in order to place the very important subject of radio-frequency current measurement on secure foundations.

Before his departure for America in April last, Mr. R. M. Wilmotte had developed at the National Physical Laboratory a method of current measurement the principle of which is similar to his method for measuring the high frequency resistance of standard inductive coils (R. M. Wilmotte, "On the Construction of a Standard High-frequency Inductive Resistance and its Measurements by Thermal Measurement", *Proc. Roy. Soc.*, vol. 109, pp. 508-522; 1925). The coils were made of mercury in glass, and the expansion of the mercury when a known radio-frequency current was passed through it for a known time could be compared with a similar expansion produced by direct current. The method for measuring current is the inverse of this. An unknown current is passed through a known resistance made of mercury, and it is then required to find the direct current which produces the same expansion of the mercury. The simplest form of resistance which can be accurately calculated at any frequency is a straight circular conductor surrounded by a concentric metal shield. In order to keep the cooling constants as steady as possible, this shield is kept in contact with ice. The column of mercury is connected to a capillary tube in which the rate of expansion of the mercury can be observed.

As previous experience had shown, the time taken for the mercury to reach a steady thermal state is too long for practical use, and it is preferable to make the measurement by observing the time, with a stop-watch, which the mercury column takes in expanding through a given length of the capillary tube. In order to secure accuracy and consistency in the readings, a number of precautions have to be taken in the construction and use of the apparatus. For example, it is desirable that the glass tube containing the mercury column should have as thin walls as possible in order that the glass may be sensibly at the same temperature as the mercury. It has also been found necessary to dry the air between the glass and the

copper screen so that no water should condense on the glass and thus alter its cooling constants.

In order to eliminate end effects, the current is led into the mercury through a special steel rod of the same diameter as the mercury column. This rod is made of non-magnetic steel with a ratio of resistivity to permeability of nearly the same value as for mercury at 0° C. In this manner the distortion of the lines of flow of the current at radio-frequencies is made inappreciable.

At the outlet end a similar arrangement is adopted, except that the steel rod is provided with a very fine capillary in order to allow the mercury to pass from the main column to the glass capillary upon which the observations of expansion are made.

Observations made with the first experimental apparatus have shown that it is possible to measure a direct current of 10 amperes consistently to a few parts in a thousand. The variation in the calibration from day to day has also been found to be considerably less than 1 per cent, and with a more suitably constructed instrument it is probable that this variation can be appreciably reduced. With the view of linking up with the low current thermal instruments which have hitherto been employed, an instrument suitable for currents of the order of 1 ampere has been designed, but certain constructional difficulties have still to be overcome.

This work is being conducted as part of the programme of the Radio Research Board established under the Department of Scientific and Industrial Research.

R. L. SMITH ROSE.

National Physical Laboratory,
Teddington, Middlesex, Oct. 1.

The Fine Structure of X-ray Absorption Edges.

IT is well known that the edges of X-ray absorption spectra are very often accompanied by secondary edges on the short wave-length side. For this phenomenon the following explanation has been proposed (D. Coster, *Zs. f. Phys.*, **25**, 83; 1924: A. Sommerfeld, "Atombau", fourth German edition, p. 326; 1924). Whereas the main edge in the case of the K-absorption line corresponds to the transition of the K-electron just to the outside of the atom, the secondary edges should correspond to a simultaneous transition of a K-electron and an outer electron by one single absorption act.

This hypothesis has been examined experimentally by D. Coster and J. H. van der Tuuk (NATURE, **117**, 586; 1926). The K-absorption line of argon was chosen because in this case there was no complication due to chemical bonds to be feared, and the experiments are easily performed by filling the spectrograph with argon of varying pressure. Though one rather weak secondary edge just near the main edge was found, which seems to be connected with transitions to different optical orbits outside the atom, no edge corresponding to a simultaneous transition of a K-electron with one or more outer electrons could be detected.

In a beautiful investigation of the absorption spectrum of iron by Lindsay and Voorhees (G. A. Lindsay and H. R. Voorhees, *Phil. Mag.*, **6**, 910; 1928. See also B. B. Ray, *Zs. f. Phys.*, **55**, 119; 1929), however, several secondary edges, some at considerable distances from the main edge, were observed. Some of these edges are explained as being due to simultaneous transitions of a K- and an M-electron, and in view of the experimental facts this seems to be the only satisfactory explanation available. In the light of the experiments on the argon edge, we must therefore conclude that such double electronic transitions are much less probable in the case of complete outer electronic shells (argon) than when one of the outer electronic shells is incomplete (iron). Recently also R. Swinne (*Phys. Zs.*, **30**, 523; 1929) has directed attention to the fact that in the case of complete outer electronic shells, fine structures are not readily observed. In agreement with this view is the fact that extremely beautiful fine structures corresponding to rather large energy differences were observed by Nishina (Y. Nishina, *Phil. Mag.*, **49**, 521; 1925) in the case of the L-spectrum of the rare earth metals and by Fricke (H. Fricke, *Phys. Rev.*, **16**, 202; 1920) for the K-spectrum of the elements in the neighbourhood of the iron group.

To test this view, K-absorption spectra were taken from metallic copper and metallic zinc. In the normal zinc atom, the M-shell is complete and the bivalency of zinc warrants that this is still the case in compounds and in the solid metallic state. Though

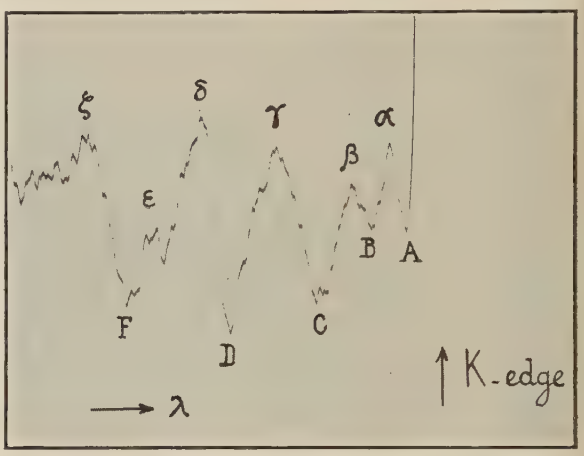

FIG. 1.

in the normal copper atom the M-shell is also complete, this is certainly not the case in the bivalent copper compounds and probably not in the solid metallic state. Indeed, there appeared to be a great difference between copper and zinc as regards their absorption X-ray spectrum. Whereas with copper a very complicated fine structure is easily obtained, until now we have not succeeded in obtaining the same for zinc, though the main edge in this case was clearly pronounced.

The photometer curve taken with the Moll photometer shows the complicated structure of the K-absorption edge of metallic copper. On the long wave-length side of the K-edge the blackening was too great to be registered on the same plate. On the short wave-length side a great number of alternating black and white lines are clearly seen; the former are denoted by Greek, the latter by Latin letters (the letter E between F and D has been erroneously omitted in the figure). Their positions relatively to the main K-edge are:

	$\Delta\frac{\nu}{R}$		$\Delta\frac{\nu}{R}$
A	1·7	α	2·5
B	3·6	β	4·7
C	6·9	γ	8·9
D	12·4	δ	13·1
E	15·5	ϵ	16·3
F	17·9	ζ	20·0

These energy differences might be connected with the energies which are required to remove a M-electron

from the copper atom from which one K-electron is already missing. These energies correspond to the M-levels for the next element (zinc), for which the following values are known: M_{I} 10·1; M_{II}, M_{III} 6·8; M_{IV}, M_{V} 0·9.

A detailed exact explanation of the observed fine structure is made very difficult by the inaccuracy of the latter numbers and the complexity of the phenomenon in question. Experiments have been started with a spectrograph of much higher dispersion in order to try to settle the unsolved problems.

D. Coster.
M. Wolf.

Natuurkundig Laboratorium
der Rijksuniversiteit,
Groningen.

The Comma Butterfly in England.

It may be of interest to put on record the fact that on Sept. 21 I saw a quite fresh-looking specimen of the Comma butterfly (*Polygonia c-album*) feeding at *Sedum spectrabile* in my garden here. My wife and I watched it together for ten minutes—several Tortoiseshells and Red Admirals were feeding also. The Comma butterfly, according to South's "British Butterflies" (published by Warne), p. 65, is "now almost entirely confined to Herefordshire, Worcestershire, and Monmouthshire". I have taken it at Chepstow years ago when I was a keen butterfly collector, but have not met with it in England since, though I have often seen it on the Continent in Corsica, Dauphiny, etc. I should doubt if a specimen of the Comma has been recorded in London for a hundred years.

F. Sherwill Dawe.
Ashburton, 67 High Road,
Chiswick, W.4, Sept. 21.

Dr. Dawe's observation serves to direct attention to a matter that is of considerable interest to students of the Lepidoptera of the British Isles in connexion with the distribution of *Polygonia c-album*. It is not an isolated one, for in 1928 a single example of the same species was noted in a garden at Twickenham, which is near Chiswick. The two records, however, provide an additional interest in the suggestion they contain that this butterfly may have established itself somewhere in the vicinity. Old records show that at the commencement of the nineteenth century the Comma was, if not actually common, at least widely distributed in England and to be met with in most counties. Its numbers gradually dwindled, however, until, towards the end of the century, it had disappeared from all the southern and eastern counties. By about 1905 it was no longer to be found, with any certainty, outside the area comprised roughly by Monmouthshire, Worcestershire, and Herefordshire, and seemed still to be rather on the wane. Records of its occurrence during the War years are somewhat scarce, but it was recorded from Eastbourne (1915), Kent (1916—last seen in 1899), Shropshire (abundant, 1917 and 1918), and Cheshire (1918). The Kentish and Eastbourne records are interesting as, taken in conjunction with others given below, they seem to suggest that the butterfly had in fact been maintaining itself somewhere in the south-east corner of England in spite of its apparent absence.

The tendency to spread in a northerly direction, that is indicated by the Shropshire and Cheshire records, appears to have given place about 1919 to a southerly and easterly trend, which is best shown chronologically as follows: 1919, Wiltshire, Essex; 1920, Somersetshire (last seen 1892); 1921, Gloucestershire, Warwick, Cotswolds, Berkshire; 1922, Devonshire, Hampshire, Buckinghamshire, Berkshire, Hertfordshire, Staffordshire; 1923, Warwickshire, Staffordshire, Buckinghamshire, Bedfordshire, Somerset, Wiltshire; 1924, Dorset, Hampshire, Sussex (Eastbourne); 1925, Berkshire, Buckinghamshire, Hertfordshire, Bedfordshire, Hampshire, Essex; 1926, Oxfordshire, Dorset, Hampshire, Sussex (Eastbourne); 1927, North Staffordshire, Nottinghamshire, Berkshire, Hertfordshire, Wiltshire, Dorset, Hampshire, Sussex; 1928, Dorset, Isle of Wight, Portsmouth, Twickenham; 1929, Devonshire, Dorset, Hampshire (abundant in New Forest), Sussex (East and West), Surrey (Walton-on-Thames), South Buckinghamshire.

The above records are taken from *The Entomologist*; no doubt supplementary data exist elsewhere. They appear to indicate fairly definitely a radial dispersal of the very attractive butterfly under discussion that commenced sometime between 1910 and 1915, and had the Wye Valley as its centre. Dispersal was primarily in a northern and north-eastern direction, afterwards mainly eastern and southern, the isolated records from Essex (1919) and Eastbourne (1924 and 1926), as already suggested, not forming part of the main phenomenon. In the present year the butterfly has undoubtedly reached the south coast throughout Dorset, Hampshire, and the greater part of Sussex, but on the other hand records from the counties through which it has passed within the last ten years are entirely lacking. Negative evidence of this kind is admittedly untrustworthy, and it would be most interesting to know whether the butterfly is in fact absent from these counties now or merely so well established in them that collectors have ceased to direct attention to its presence.

It may, of course, be argued that the facts recorded above are as readily to be explained by a sudden general increase in population among very small and hitherto overlooked colonies scattered throughout the area under consideration, as upon the hypothesis of a migration from the Wye Valley area, but the evidence in my opinion favours the latter view. In either case, however, no suggestions have been made that would account for it. The principal food-plants of the caterpillar are, in order of preference, hop, nettle, and currant, none of which appears to occur now any more generally or plentifully than formerly.

N. D. Riley.
British Museum (Natural History),
Cromwell Road, London, S.W.7,
Oct. 9.

Electrical Phenomena of Crystals floating on a Saturated Aqueous Solution.

At the end of 1926 a student under my charge named M. Simizu found that crystals of acetanilide formed a regular arrangement on the surface of the saturated aqueous solution of acetanilide. He had filtered the crystals produced by boiling aniline and acetic acid (J. B. Cohen, "Practical Organic Chemistry", p. 151, 1920), and discovered this after leaving the filtrate for two days.

I have since then undertaken the following experiments. On bringing a glass rod near the crystals these floating crystals were all attracted to the end of the rod; that is to say, they had *free* electric charges. The charge was positive, because they were attracted strongly by a sulphur rod rubbed against wool and were repelled by a glass rod rubbed against silk. The solution was weakly acidic to litmus paper.

Dissolving acetanilide, purified by frequent recrystallisation, in ordinary distilled water, acidifying it

with acetic acid, and finally cooling it, I found that small crystals appeared on the surface of the solution. These formed a regular arrangement more striking than those described above and reminded me of the famous experiment of Meyer's floating magnets; for example, when seven crystals were present, they arranged themselves in a right hexagon, one of them placing itself in the centre.

The crystals thus had a fair amount of *free* charge, the charge being positive. When they were small (for example, 0·8 mm.), the crystals thus crystallised out of the saturated solution would separate themselves from each other by mutual repulsion. When, however, the crystals were larger, they would not separate if they were once brought into contact. Moreover, they would attract one another and come into contact though they were separated by a small distance from one another. This is due to the capillary effect.

According to Perrin's explanation of the phenomena of electrical endosmose (Perrin, *J. Chim. phys.*, **2**, 601; 1904), crystals of naphthalene and other compounds acquire positive charges by the adsorption of hydrogen ions in acidified water. When they are in alkaline solution, by the adsorption of hydroxyl ions they acquire negative charges. In the case of acetanilide also, a layer of the ions is produced on the surface of the crystals by selective adsorption, and at the same time a diffusion layer of the ions with the opposite charge is also produced outside of the former layer. If the latter layer of ions can slip in the electric field, it is clear that the crystals move towards one direction in the field.

It was ascertained that the crystals of acetanilide deposited from the pure aqueous solution have negative charges. Using the same apparatus as was adopted by Perrin when he examined electro-endosmose, and putting a porous diaphragm made with melted acetanilide between the cathode chamber and anode chamber, ordinary distilled water saturated with acetanilide was poured into these two chambers and a D.C. source of 120 volts was applied. Then it was observed that the solution of the cathode chamber rose, while the level fell when the polarity of the electrodes was reversed. From this it is clear that the wall of acetanilide is charged negatively.

When some acetanilide was put into distilled water, heated until the solution became saturated, and cooled, the first crystals produced were polygonal plates, and had a free charge of negative sign. When acetic acid was added to this solution, the crystals that had negative charges acquired positive charges, for they were easily attracted by a sulphur rod rubbed with wool.

In experiments in other solvents than water, for example, chloroform, benzene, toluene, and water containing ethyl alcohol, no charged crystals were found.

The origin of the large quantity of *free* charge on the crystals and the electrical phenomena of crystals other than acetanilide are under investigation.

NOBUYUKI KATOH.

Yokohama Higher Technical School.

High-frequency Discharge in Organic Vapours.

WHILE studying the rectification effect in some organic vapours, when ionised by electrodeless discharge, striations unlike the general type obtained by McCallum and Perry (NATURE, Jan. 12, p. 48) were observed to fill the whole tube. The diameter of the tube was different at different parts, varying from 0·5 cm. to 2·5 cm., but there was observed no essential difference in the pattern anywhere excepting their increased luminosity in the narrower portion.

The pattern appeared like a helix, with five or six rings per centimetre and would rotate rapidly about its axis. All these rings are not parallel to one another, and during their rotation they get inclined owing to the non-uniformity of the field in its proximity. They present a wave-like appearance, as has been observed by K. A. MacKinnon and J. K. Robertson (NATURE, July 13, p. 55). It has also been observed in some cases that on prolonged working, the striations separated themselves into groups, presenting the appearance of nodes and antinodes in Kundt's tube phenomena. This happens only when the slip electrodes which are the seat of damped oscillations are brought close together.

Striations in the vapours were observed at a lower wave-length than in the case of air; and also at the same wave-length they would come out quicker in

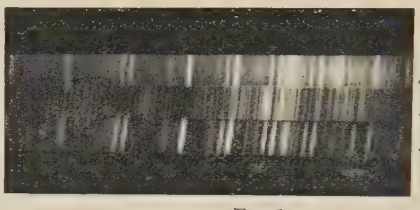

FIG. 1.

vapours than in air, as is expected from the non-ionising collision and absorption of energy in the case of heavy molecules (J. J. Thomson, *Phil. Mag.*, July 1929).

The glow of the striations may be made to extend beyond the electrodes, whether an internal or external electrode is used, provided there is a chance of stray capacity effect. This is very clearly shown when an earthed tin-foil is wrapped over the tube at any remote part of it.

Incidentally, it was also observed that these vapours when ionised give rise to band spectra. The accompanying photograph (Fig. 1) shows such an effect when propyl bromide was used, but we are not yet sure of the emitter of these bands. Investigations in this laboratory are being carried on to study the band spectra of some simple molecules when ionised by this method of electrodeless discharge.

P. N. GHOSH.
B. D. CHATTERJEE.
University College of Science and Technology,
Calcutta, Sept. 19.

Dr. Augustus Waller and Patents.

IN the "Calendar of Patent Records", page 562, NATURE, Oct. 5, it is stated that Dr. Augustus Waller patented, in 1852, a means for measuring the quantity of alcohol in liquors; "but" (quoting from the paragraph in NATURE) "his most important invention —the cardiograph . . . was not patented".

The Dr. Augustus Waller who is reported to have obtained this patent, and who in 1852 was engaged on his neurological researches, was the father of Dr. Augustus Désiré Waller, who first observed and recorded the human electrocardiogram.

The patent may well have been the result of some hobby of his spare time, but neither my grandfather nor my father patented any results of the researches through which they are now remembered by physiologists.

MARY D. WALLER.

5 Gloucester Gate,
London, N.W.1.

Sexual Behaviour in Birds.

By Dr. F. H. A. Marshall, F.R.S.

In recent years the intensive observation of birds living in a state of Nature has led to the development of a branch of study which is not only full of interest to the outdoor naturalist, but may be as strictly scientific as the work of the museum specialist or the laboratory observer. The pioneer in this movement was undoubtedly Gilbert White, about whose book on "The Natural History of Selborne" it has been said that, together with Bewick's "History of British Birds", it has been the main contributory cause of that widely spread interest in ornithology which has been so apparent in Great Britain since the beginning of the last century.[1]

White's observations on bird behaviour, unique though they were at the time that they were recorded, were nevertheless scanty, and we have to pass over nearly a hundred years before the general interest in bird-watching received a new stimulus from the close and detailed studies of W. H. Hudson, whose virtue it was to combine great literary merit and scientific exactitude with an intense sympathy for the animals observed. Of more importance than Hudson's work, as showing a wider biological outlook and a greater scientific precision, are the recorded observations of Eliot Howard[2] and Edmund Selous,[3] both of whom have concerned themselves with the sexual behaviour of birds and its physiological and evolutionary significance. Mention must also be made of the work of Julian Huxley,[4] whose studies on courtship phenomena have not yet received the full recognition they deserve.

Selous's most important scientific work is probably that dealing with sexual selection and the extension of that principle to birds which are decorated in both sexes and display mutual courtship—a principle to which he applies the term inter-sexual selection. This phenomenon may be seen to a greater or less extent in grebes, divers, shags, guillemots, oyster-catchers, and avocets, besides various other birds, and has been observed independently by Huxley. In some species the usual parts played by the sexes are definitely reversed, as shown by Huxley for the great crested grebe. Eliot Howard's investigations likewise deal mostly with breeding phenomena, and in particular with the territory theory which he has put forward and supported with a wealth of detailed observation to explain the meaning of the complete change of habit shown by many passerine birds and some others when they take up their breeding quarters. But it is to Howard's more recent but related work on the phases of the reproductive cycle and their physiological significance that I desire to refer chiefly in this article. The recorded observations are upon the outward behaviour of birds during the breeding season, yet, as the author himself emphasises, each phase of activity must be correlated with internal changes in the bird's sexual state, without a knowledge of which the behaviour of the individual cannot be adequately explained. For birds the necessary data for a full interpretation do not at present exist, for the subject has scarcely begun to be investigated. Nevertheless, a consideration of what is known in this connexion concerning the changes undergone by the reproductive organs of other animals may point the way to further work and provide some clue to the interpretations which will some day be forthcoming.

In the spring, in response to some stimulus which is partly internal and partly external, buntings and various other birds which form flocks in the winter, assume isolated positions or territories which later become their breeding quarters and from which they exclude other birds of their own species. In the same way warblers and other migratory birds, soon after their arrival from southern lands, acquire territories, and these they continue to hold until the young are able to look after themselves and the breeding season is over.[5] Howard has shown that the territories are first occupied by the male birds alone and are held by them against other comers for some days or weeks before the arrival of the females. The latter leave the flock, which is thereby broken up in response to some sudden impulse, and commence to wander until attracted by the song of the males with which they afterwards mate. In the case of migratory birds also, the females commonly arrive after the males.

Mating is not at first followed by sexual intercourse, but there is in the female a period of preparation which Howard compares with the proœstrum of the mammalian female, and this period is often very prolonged. In buntings the proœstrum is characterised by sexual flight and there is some posturing on the part of both sexes, but it is not until the next period, which corresponds to the mammalian œstrus, that coition occurs. (There is no evidence of a synchronous physiological change in the male, which is probably capable of intercourse at the time of the female's proœstrum.) Howard remarks that the value of posturing chiefly lies in the œstrous phase, its purpose being the provocation of sexual reaction by mutual stimulation. During the phase of proœstrum, instead of there being one form of stimulation, there are a number—voice, appearance, and movement. At œstrus, the female bird, instead of flying or shuffling away on the approach of the male, stays, raises her tail and quivers her wings. "A stonechat flutters one or both wings; a willow wren flaps them; a guinea fowl rushes along the ground, checks herself, and lies on the ground with wings

[1] Newton, A., "Dictionary of Birds" (1896).
[2] Howard, H. Eliot, "The British Warblers" (1914); "Territory in Bird Life" (1920); "An Introduction to the Study of Bird Behaviour" (1929).
[3] Selous, E., "Realities of Bird Life" (1927).
[4] Huxley, J. S., *Proc. Zool. Soc.*, 1914; *Journal Linnean Soc.*, 1923.
[5] Nicholson, E. M. ("How Birds Live." Second edit., 1929), says that greenfinches, lesser redpoles, linnets, and serins tend to nest in communities and do not form territories.

outspread; a hedge sparrow quivers her wings and springs a few inches from the ground, and so we might give a long list of the different fashions in which females disclose sexual reaction".

There can be little doubt that the simultaneous bobbing up and down of the head and neck by the drake and duck in the water, the bowing and puffing out of the neck by the wood pigeon, which at the same time coos loudly and fans its tail, and the similar display by the lapwing and other birds, are all proœstrous or œstrous phenomena, and belong, therefore, to the same category, though not necessarily showing that the birds are ready for immediate coition. In these cases the display can have no significance in relation to preferential mating as postulated by Darwin's theory of sexual selection, for it concerns a pair of birds which have already mated, although, as Selous has recently shown, preferential selection of the male by the female undoubtedly follows the courtship antics of the ruff and the blackcock. In most birds, however, in which mating occurs before posturing,[6] the latter must be supposed to have a physiological significance, and Howard has shown that this probably consists in its securing an effective synchronisation of the reproductive capacities of the male and female.

Light is thrown upon this subject by the older observations by E. H. Harper on egg-laying in the domestic pigeon. This author writes as follows:

"When a pair ready for mating is put together, egg-laying ordinarily ensues at the end of a rather definite period, at the least eight days. The female functions are held in abeyance till the proper stimulus is received from a mate. The maturing of the egg is so exclusively a female function that it seems odd at first thought that an apparent exception should occur to the rule. Of course, we know that the final maturation of the egg, or the giving off of the polar bodies, awaits in most animals the act of fertilisation. But here the effect is produced upon the egg by the entrance of sperms. How mating and the act of copulation (which is repeated at frequent intervals every day at this time) could influence the ripening of the egg in the ovary is another problem. In this connexion the curious fact must be mentioned that two female pigeons placed in confinement may both take to laying eggs. The function of ovulation is in a state of tension, so to speak, that requires only a slight stimulus, 'mental' apparently in this case, to set the mechanism to working. At any rate, it is impossible to regard the presence of sperm in the oviduct as an essential element of the stimulus to ovulation, although it may have an important influence in the normal case. Our attention is directed to the various and complex instincts of the male which come under the head of courtship, both before and after mating is effected, as furnishing a part of the stimulus to the female reproductive organs." [7]

Harper proceeds to describe a curious habit which is common among pigeons before copulating. The male bird regurgitates some secretion in its throat, and this is taken up by the bill of the female in much the same manner as the young take their food. "It is easy to see that here may be one of the sources of indirect stimulation to the female reproductive organs." Numerous observations on the pigeon have been made also by C. O. Whitman,[8] who speaks of posturing as self-stimulating.

To elucidate the subject further we pass to the mammal. It was observed long ago by Walter Heape [9] that, in the rabbit, ovulation or the discharge of the eggs from the ovary is dependent upon coition, and that it takes place approximately ten hours after coition. During the intervening time, the egg undergoes the characteristic maturation changes. The actual process of ovulation has been observed in anæsthetised rabbits the ovaries of which were exposed.[10] Similarly, it has been found that the ferret depends upon coition for the rupture of the follicles and the discharge of the ova. The injection of semen is not essential, for ovulation occurs after copulation with a sterile male. There is evidence that in the sheep also at the end of the sexual season the stimulating power at the disposal of the ewe is not sufficient to admit of spontaneous ovulation at the œstrous periods, and that in the non-occurrence of coition the egg is not discharged.[11] Further, it has been observed in rabbits that if two does 'on heat' are kept together and 'jump' one another after the manner of cows in that condition, ovulation may occur as a result of sexual excitement and in the absence of the male.[12] The latter process is clearly comparable to what Harper and Whitney have observed in pigeons. In all these cases it would seem evident that ovulation is brought about by a nervous stimulus which may be due to the orgasm or to the sexual excitement which is an accompaniment of posturing.

Additional light has been thrown on the problem by recent investigations on the anterior lobe of the pituitary body, and more particularly by C. W. Bellerby's researches.[13] By intravenous injections of extract of anterior lobe into an œstrous rabbit kept under anæsthesia, Bellerby has been able to bring about ovulation experimentally at about the same time after injection as it occurs normally after coition (to be precise, at $11\frac{1}{2}$ hours after). He suggests, therefore, "that the act of copulation, or the orgasm resulting from it, stimulates the anterior lobe of the pituitary to secrete into the blood-stream a hormone that initiates in the follicle those internal changes that finally result in its rupture".

In view of the facts above cited, there is a strong presumption that sexual posturing in birds has a definite physiological significance in that it exercises a stimulating influence upon the anterior lobe of the pituitary body, thereby causing it to secrete in greater quantity and so bring about those ovarian processes which result in egg-laying. The mechanism is perhaps comparable to the

[6] According to Nicholson, mating with hawfinches commences in February and before the breaking up of the flock.
[7] Harper, E. H., *Amer. Jour. of Anat.*, vol. 3, 1904.
[8] Whitman, C. O., "The Behaviour of Pigeons" (1919).
[9] Heape, W., *Proc. Roy. Soc.*, B, vol. 76, 1905.
[10] Walton, A., and Hammond, J., *Brit. Jour. of Exp. Biol.*, vol. 6, 1928.
[11] Marshall, F. H. A., *Phil. Trans.*, B, vol. 196, 1903; *Quart. Jour. Micr. Sci.*, vol. 48, 1904.
[12] Hammond, J., and Marshall, F. H. A., *Proc. Roy. Soc.*, B, vol. 87, 1914.
[13] Bellerby, C. W., *Proc. Physiol. Soc., Jour. of Physiol.*, vol. 67, 1929.

secretion of the suprarenal glands in animals as a result of strain or emotion in the manner postulated by W. B. Cannon.[14] This conclusion is of course speculative, but it is to be pointed out that the anterior lobe is supplied by sympathetic nerve fibres which are probably derived from the superior cervical ganglion.[15]

That the anterior lobe of the pituitary is functionally correlated with the sexual organs is now definitely established, but the precise sequence of events leading up to the phenomena associated with œstrus is yet to be determined. P. Zondek and S. Aschheim,[16] P. E. Smith and E. T. Engle,[17] A. S. Parkes [18] and others have shown that anterior lobe extracts injected into mammals exert a powerful stimulating action upon the gonads, increasing in the female the number of follicles available for ovulation eight or ten times, besides affecting the other ovarian functions in a marked degree. That such a correlation exists in the birds has been shown by Oscar Riddle,[19] who found that the grafting of anterior lobe tissue or the injection of extracts into immature ring-doves promoted the growth of the gonads in both sexes and accelerated the attainment of sexual maturity.

It is no less evident that the gonads are themselves responsible for the development of sexual change, as is indicated negatively by the familiar effects of castration and oöphorectomy. W. Rowan [20] has suggested that the periodic growth of the gonads provides the necessary stimulation for migration, and the non-existence of the migratory instinct in sterile birds is consistent with this view. Moreover, Rowan has shown experimentally in the Junco (*Junco hymenalis*) that a premature recrudescence of the gonads, brought about by the use of artificial light from powerful electric bulbs, induced the birds to fly away, although the season was inappropriate, being mid-winter, whereas control birds with undeveloped gonads did not migrate but remained close at hand.

As to whether the gonads react upon the anterior lobe of the pituitary, there is at present no evidence excepting that in mammals the gonads seem to control the sexual cycle. In reality there is probably a complicated cycle of processes in which the thyroid and other endocrine organs play their part. The most that can be said at present is that certain links in the chain of causation can be demonstrated and that Eliot Howard is probably right in his conclusion that mutual posturing in birds secures an effective synchronisation of the essential reproductive conditions of the male and female, and so promotes the successful fertilisation of the eggs, a conclusion which he has reached as a result of prolonged and intensive watching of birds in a state of Nature.

[14] Cannon, W. B., *Amer. Jour. of Psych.*, vol. 25, 1914; *Amer. Jour. of Physiol.*, vol. 33, 1914.
[15] Sharpey-Schafer, E., "The Endocrine Organs", vol. 2 (second edition, 1926).
[16] Zondek, Paul, and Aschheim, S., *Klin. Wochensch.*, vol. 6, 1927.
[17] Smith, P. E., and Engle, E. T., *Amer. Jour. of Anat.*, vol. 40, 1927.
[18] Parkes, A. S., *Proc. Roy. Soc.*, B, vol. 104, 1929.
[19] Riddle, O., and Flemion, F., *Amer. Jour. of Physiol.*, vol. 87, 1928.
[20] Rowan, W., *Proc. Boston Soc. of Nat. Hist.*, vol. 38, 1926; cf. F. H. A. Marshall, "The Physiology of Reproduction" (second edition, 1922).

Molecular Air-Pumps.[1]

By Prof. E. N. da C. Andrade.

According to the kinetic theory a gas consists of molecules, which may be considered as little spheres, or, more generally, as little bodies of a more or less marked degree of symmetry, about a hundred-millionth of an inch long, rushing about in all directions and frequently colliding with one another and with the walls of the vessel. The collisions with the walls produce the pressure. The molecules move with a very high velocity, some hundreds of yards per second for gases at ordinary temperature, and this high velocity deduced from elementary considerations, was a point of difficulty in the early days of the theory, critics objecting that such speeds would imply very rapid diffusion, so that, for example, the vapour of any odorous liquid should be detected by its smell at the furthest parts of a room as soon as the bottle is opened. Such criticism leaves out of account the frequent collisions, which make the path of an individual molecule a zigzag with frequent turns back on itself. The average distance between collisions is called the mean free path, and is an essential factor in all questions of diffusion and of viscous forces. It is about a hundred-thousandth of a centimetre for air at ordinary pressure, and is, to a first approximation, independent of the temperature. It varies, with a given gas, inversely as the pressure, so that at low pressures it becomes quite large: in air at a pressure of 1 microbar it is 10 cm., and at a pressure of 0·01 microbar, easily attained with modern technique, it is 10 metres.

If we consider the passage of a gas through a tube of any kind, a change in the laws governing the movement begins to manifest itself when the pressure becomes low enough for the mean free path to be about equal to the linear dimension of the cross section of the tube. The physical reason of this is clear: at higher pressures most of the collisions are between molecules, collisions with the walls being comparatively infrequent; at very low pressure collisions with the walls are common compared with those between molecules, and dictate the nature of the bulk movement of the gas. Knudsen, who studied the flow of gases through tubes at very low pressure, found that his results could be explained on the supposition that the molecules which struck the walls did not bounce off at the reflecting angle, like tennis balls from a smooth floor, but came off in random directions, like tennis balls thrown into a crowd, where they are caught and thrown up again at hazard. The gas behaves as if momentarily condensed on the wall, and then re-evaporated. He worked out the consequences of such behaviour, and deduced laws

[1] From a discourse delivered at the Royal Institution on Friday, May 31.

which he found to agree closely with experiment. If the quantity Q of gas issuing be measured by the volume multiplied by the pressure at which it issues, then

$$Q = pv = \frac{4}{3}\sqrt{2}\pi\ (p_2 - p_1)\ \frac{r^3}{l}\ \frac{1}{\sqrt{\rho}}\ t,$$

where ρ is the density of the gas *at unit pressure*; p_1 and p_2 are the pressures at the two ends of the tube respectively; r is the radius and l the length of the tube; t is the time. This formula shows that a gas at low pressure will take a surprisingly long time to pass through quite a wide tube into a perfectly exhausted vessel. For example, suppose a volume of 2 litres, containing air at 15° and at a pressure of 10 microbars, connected by a tube 50 centimetres long and 5 millimetres in diameter to a second vessel in which a pump maintains a pressure of only 0·01 microbar. It will take 5 minutes for the pressure in the first vessel to fall to 0·2 microbar. Many physicists who are familiar with this speak, however, as if the resistance to flow at low pressure were *greater* than that which we should anticipate if the ordinary law of flow which holds for higher pressure, namely,

$$Q = pv = \frac{\eta\,(p_2 - p_1)}{8\,\eta\,l}\ p\ r^4,$$

with constant coefficient of viscosity η, held down to very low pressures. This is, however, incorrect, the resistance at such low pressures being less than if the normal laws of viscosity were valid. For example, if we take oxygen at such a pressure that the mean free path equals the radius r of the tube, we find that Knudsen's formula indicates rather more than four times as much gas passing through under a given pressure difference as would issue if the ordinary viscosity formula were applicable. The reason that, even so, wide tubes offer such a large resistance to the flow of gases at low pressure, is that the driving difference of pressure is very small. It is therefore necessary with all modern vacuum pumps to have very wide connecting tubes, made as short as possible, and very wide bore taps, if exhaustion is to proceed efficiently.

Considerations of the behaviour of gases at low pressure led Gaede in 1912 to design a new type of pump, termed by him a molecular pump. Since the molecules behave as if condensed on the surface and then quickly re-evaporated, if we move the surface rapidly we communicate a common velocity component to all molecules. If, then, part of the walls of a tube could by some means be kept in steady motion in the direction of the length of the tube a difference of pressure would be maintained between the two ends of the tube, the tendency of the gas to flow under the difference of pressure being counteracted by the drift imposed on the molecules. Calculation shows that with a given gas the *ratio* of the pressures at the two ends is fixed by the speed of the walls and the length of the tube. If the ordinary laws of viscosity were valid at these low pressures the *difference* of pressure would be fixed in this way. Clearly the ratio of pressure also depends upon the ratio of the speed of the gas molecule to the speed with which the walls move, so that at a given temperature this pressure ratio is much less for hydrogen than for a heavier gas.

In Gaede's pump the walls of the supposititious tube, which has just been discussed, are constituted by grooves cut in a drum which can be set in very rapid rotation. The drum fits closely into a housing from which a tongue protrudes into each groove, dividing the groove into a low-pressure side, where the walls are running from the tongue, and a high-pressure side, where the walls are approaching the tongue. The high-pressure side of one groove is connected to the low-pressure side of the next groove, so that we have virtually several pumps in series. A preliminary pressure of a fraction of a millimetre of mercury (say 0·1 mm.) is necessary to ensure the efficient working of this type of pump, but with such conditions a very low vacuum can be rapidly attained. A great advantage of pumps of this type is that they deal with condensable vapour as readily as with gases.

Another form of molecular pump has been recently designed by Holweck. In this pump a spiral groove is cut in the casing, and the drum has an unbroken cylindrical surface. The depth of the groove is tapered so as to allow for the decrease of mean free path with increasing pressure.

We now turn to another type of pump which has come into great general use in the last few years. As a preliminary let us consider the influence of a volatile liquid on a vacuum, in particular the question of obtaining a high vacuum in a vessel connected to which by a wide tube is a second vessel containing a liquid.

A celebrated German text-book of physics, published in 1906, says, for example, "If a receiver containing a little gas is in connection with a pump that contains mercury, the pressure of the gas cannot be less than 0·0013 mm. (the vapour pressure of mercury), and if there is mercury vapour in the receiver the total pressure cannot be less than 0·0013 mm. of mercury". This sounds reasonable, and is indeed true so long as everything is at rest and the problem is a statical one. It need not be true, however, if the vapours are streaming. We can, for example, actually connect a receiver to another vessel containing boiling mercury, and yet have a very low pressure in it. To do this we put a liquid air trap in between; the pressure in the trap is very low indeed, and there is a continuous stream of mercury vapour into it; the vapour condenses and the pressure in the receiver remains exceedingly low.

Gaede obtained some very interesting results by connecting a vessel containing a little air with a vessel of heated mercury, with an ice-cooled trap between the two vessels. If the total pressure of gas and mercury vapour were the same in both vessels, then, since there is only air in one, when the mercury is heated sufficiently to give this pressure, there should be no air in the other. However, it was found that air diffuses into the mercury vapour space against the current of vapour. The laws of diffusion are somewhat complicated, but Gaede worked out the case in detail, everything

being at low pressure, and his results led him to devise his mercury vapour pump.

The principle is to let the gas diffuse into a rapid stream of mercury vapour which carries it away to a place where it can be removed by a rough pump. The vapour stream is produced by strongly heating liquid mercury; vapour which diffuses into the receiver space is condensed. Although the fore-vacuum is necessarily at a higher pressure than the receiver, gas cannot get back against the stream of mercury vapour. The pump will only work well at low pressure, for unless the mean free path is long the diffusion process does not become really operative. To render the diffusion effective Gaede used a slit, which diminishes the counter-current of mercury vapour. This case can be worked out mathematically, and it can be shown that diffusion is most effective when the width of the slit is equal to the mean free path of the gas. If the slit is too wide the density of the mercury vapour is too great, and the 'brush' action of the slit loses its sharpness; if it is too narrow not enough gas molecules diffuse through. Similarly, if the vapour pressure is too high the counter-current is too vigorous; if it is too low the stream is not fast enough.

A better arrangement of the vapour stream was devised by Langmuir. In his type of pump the vapour issues through a tube, which is surrounded by a wider tube, the walls of which are water-cooled. The tube to the receiver enters the outer tube at a point in the rear of the vapour jet. If the pressure is so low that the mean free path of the vapour is greater than the distance between the tubes, the molecules cannot diffuse back against the gas stream, but strike the wall and condense. It is true that a much lower temperature than the boiling point of mercury is needed for condensation at such low pressures, but with tap-water cooling the condensation is fairly effective. The importance of condensation is clear, and Langmuir called his pump a condensation pump, but the gas enters the vapour stream by diffusion just as in Gaede's pump. Both the original Gaede pump and Langmuir's pump are really diffusion-condensation pumps.

The different types of diffusion pump all need a good preliminary vacuum, as they cannot hold up against more than a slight difference of pressure without gas coming back against the vapour stream. A fore-pump producing something between a tenth and a hundredth of a millimetre of mercury should be employed. However, at higher pressures, where the diffusion effect is small, we can use the steam-injector principle, for in a jet of fast-moving comparatively dense vapour there will be a diminution of pressure corresponding to the kinetic energy of the accelerated vapour. The surrounding gas will flow in as a whole under the difference of total pressure, not partial pressure. This principle has been used for the creation of a fore vacuum by a vapour stream. In Gaede's three-stage steel mercury-vapour pump, for example, which has great speed of pumping, there is an injection stage working at comparatively high pressure, and a diffusion stage for the lowest pressure, while in between there is a stage of mixed action.

Mercury is not the only liquid which is suitable for use in a vapour pump. Quite recently Mr. Burch, by a process of distillation *in vacuo*, has obtained an oil the vapour pressure of which at ordinary room temperatures is extraordinarily low. This oil can be used effectively as the working fluid in pumps. Another liquid which can be used is normal butyl phthallate.

In addition to the types of vacuum pumps to which reference has been made, it must be remembered that other processes are widely used, especially in industrial laboratories, for producing high vacua. Solid surfaces in general exercise a marked condensing action on gases, and absorb on themselves thin layers of gases at temperatures and pressures under which the substance is gaseous in bulk. Consideration of these surface actions lie outside the scope of this discourse, as do the methods of combining the residual gases chemically with a substance which deposits on the walls of the glass, by the use of the so-called 'getters'. We may, however, with reference to the part which the walls of the vessel play in these processes, refer to these methods as *mural* methods. If we are allowed to do this we may alliteratively divide the methods of producing high vacua into *mechanical*, as exemplified not only by the Geryk pumps, and box-pumps, but by all pumps, such as the Gaede rotary pump, in which a portion of the gas is cut off and bodily expelled; *molecular*, including in this term both what is ordinarily called the molecular pump and also the vapour stream pumps, since they are based upon molecular theory; and *mural*. The action of the first is perfectly understood; the action of the second is largely understood, but more difficult; the third method, though widely applied, is theoretically still very obscure in many cases.

Finally, it may be mentioned that while pressures as low as a ten-thousand-millionth of atmospheric pressure can be certainly produced in the laboratory, even at this pressure more than a thousand million molecules are present in every cubic centimetre. We are still very far from being able to produce the kind of vacuum that exists in outer space.

Obituary.

Dr. C. Easton.

On June 3, 1929, Dr. Cornelis Easton died at the Hague at sixty-four years of age. Though he was not professionally engaged in science, his work attracted the attention both of astronomers and of meteorologists, and a short account of his life and work, abstracted from a contribution by Dr. J. Stein, S.J., to *Hemel en Dampkring*, July-September 1929, may interest readers of Nature.

Born at Dordrecht on June 10, 1864, Dr. Easton attended schools there and passed the entrance examination to the Polytechnicum at Delft in 1881. From early youth the stars had interested him, and one of his teachers encouraged observational

work, so that even during his student's time at Delft he began observing the Milky Way with the view of producing an exact picture of Galactic details and nuances. Though he left his technical studies in 1884 for a literary career and eventually became editor of a leading newspaper, he continued his astronomical work, and after many difficulties, succeeded in 1893 in publishing his first and important work: "La Voie lactée dans l'hémisphère boréal", containing four maps in lithography, prepared with the author's assistance and under his supervision.

This work, which was very favourably received by professional astronomers, was followed by a series of papers dealing with the distribution of the stars near the Galactic system. The principal view put forward is that the Milky Way must be considered as a spiral with two principal curves, a centre in Cygnus, secondary streams going in the direction of Perseus and Ophiuchus, the sun in a rather open space between the windings. The theory was further developed in "A Photographic Chart of the Milky Way and the Spiral Theory of the Galactic System" (*Astrophys. Journal*, **27**, Mar. 2, 1913). The original maps on which this photographical chart was based, were partly published this year (*Monthly Notices R.A.S.*).

In the meantime another research had been undertaken, and in 1903 the result appeared in the memoirs of the Kon. Akademie van Wetenschappen at Amsterdam, "La distribution de la lumière galactique comparée à la distribution des étoiles cataloguées dans la Voie lactée boréale," followed by other treatises on the distribution of nebulæ (1904) and the distance of galactic starclouds (1921). Soon after the first of these publications, June 13, 1903, he obtained from Kapteyn's hands the honorary degree of doctor of the University of Groningen.

Easton's important studies on periodicity in climate ultimately led to the publication of his book: "Les hivers dans l'Europe occidentale", recently reviewed in NATURE. This work, like that on the Milky Way, involved careful and patient collection and criticism of a vast amount of material, and apart from the value of the results regarding periodicity, it will form a basis for other theoretical investigations. The principal conclusion in favour of an 89-year cycle in the frequency of severe winters certainly was confirmed by the severe winter 1928–29.

Of course, a journalist so well acquainted with astronomy and meteorology, which appeal most to the general public, had an excellent opportunity of popularising these sciences in the papers, and he did so with great success. This was one of the reasons why Easton was chosen as a member of the board of visitors of the Royal Dutch Meteorological Institute of the Netherlands. Since 1921 he was president of the Society for Meteorology and Astronomy, and since 1922 chief editor of its periodical, *Hemel en Dampkring*, which was much extended under his leadership. In every respect Easton will be very difficult to replace, but his work remains and will long continue to be appreciated. E. VAN E.

PROF. LOUIS CAPITAN.

THE death is announced from Paris of Prof. Louis Capitan, one of the foremost French archæologists of the day. M. Capitan was a doctor of medicine, a member of the Academy of Medicine, and had for many years been a professor at the École d'Anthropologie. He was the author of numerous communications dealing with archæological subjects which appeared in French scientific periodicals, and especially in *L'Anthropologie*.

With various collaborators Prof. Capitan was responsible for several of the magnificent publications dealing with the exploration of the French palæolithic caves, which appeared under the patronage and with the subvention of the Prince of Monaco and under the auspices of the Institut de Paléontologie humaine. "La Caverne de Font de Gaume", written with MM. Breuil and Peyrony, was published at Monaco in 1910. "Les Combarelles aux Eyziès", written with the same collaborators, appeared in Paris in 1924. Other volumes were "Limeuil, son gisement à gravures de l'âge du Renne", Paris, 1924, in collaboration with M. Bouyssonière, and "La Madeleine", Paris, 1928, of which M. Peyrony was joint author.

M. Capitan was a strong supporter of the view which claims a very high antiquity for the art of flint working, and argued forcibly that the flints of earliest date from East Anglia for which an artificial origin was claimed were rightly attributed to man or a pre-human precursor of man. The ground for this conclusion which appealed most strongly to him was a classification of the specimens into 'artificial' and 'natural' based upon his long experience in handling flint implements in large numbers. In fact he had practically reached the position that the final test of the eolith was a judgment which had become almost intuitive as the result of experience—a subjective test which was likely to appeal more to its author than to his audience.

M. Capitan was also keenly interested in Americanist studies. He was one of the French delegates who attended the International Congress of Americanists held in London in 1912, and in 1914 he published, with the assistance of M. Lorin, a book entitled "Le travail en Amérique avant et après Colombe". He was actively concerned in the record and preservation of ancient monuments, and took a prominent part in relation to a projected series of archæological maps, recording the existence and distribution of prehistoric monuments, for which he hoped to obtain international co-operation.

MR. E. H. MAN, C.I.E.

WE regret to record the death of Mr. Edward Horace Man, which took place on Sept. 29 at Preston Park, Brighton. Mr. Man, who was formerly in the Indian Civil Service, retiring in 1901, was born in 1846. As a young man he was appointed to the Andaman Commission, and not only entered into close and friendly relations with the

aboriginal tribes, but also made them the subject of close study. In this he ran no inconsiderable personal risk, for the tribes were then and continued for many years to live in an entirely wild state. Not only did they raid the settlements but many of them resented, and often actively resisted, European visitation, especially if its object were punitive.

Mr. Man's relations with the Andaman Islanders were, however, normally of a happier nature, and he was thus able to visit and study them in their native haunts. As a result he became, and continued to be until the end of his life, our foremost authority on Andaman beliefs and customs. His work has been supplemented by the work of Sir Richard Temple, who for some years was resident High Commissioner, and by that of Prof. A. R. Radcliffe-Brown; but Mr. Man's records will always be the main authoritative source of information relating to this important and interesting relic of a primitive stage in human culture.

The results of Mr. Man's observations were embodied in a number of papers contributed from time to time to the *Journal of the Royal Anthropological Institute*. These, with other material, were afterwards published in his "The Aboriginal Inhabitants of the Andaman Islands" (1883). He also published a grammar and dictionary of the Central Nicobarese and South Andaman languages and contributed frequently to the *Geographical Journal* and the *Journal of the Royal Asiatic Society*, as well as to the *Indian Antiquary*, the editor of which, Sir Richard Temple, has recently still further contributed to our knowledge of the Andamanese in notes appearing in that periodical. Mr. Man made a large collection of photographs of the Andamanese which are deposited with the Royal Anthropological Institute.

News and Views.

The Royal Commission on National Museums and Galleries has carried out its labours expeditiously. Scarcely more than a year after its appointment it issued an interim report, accompanied by a volume of evidence and memoranda, and now the first part of the final report has appeared and the second is promised at an early date. The Commission's terms of reference suggested a roving commission through the institutions containing the national collections, and there was a danger that a too close interpretation of them might have led to a prolonged inquiry in which useful conclusions would have been lost under a dead-weight of detail. This danger has been seen, and has been avoided by the concentration of attention on the main aspects as they presented themselves to the commissioners in the course of their extensive investigation. The present report, therefore, deals with the more general aspects of the relationships of museums to the public and to each other, as well as to the state. It examines the actual workings of the different institutions, and makes many suggestions for more efficient methods, for example, of exhibition and of storing, of co-ordination and co-operation, and of public contact. It stresses the need of central co-ordination, and suggests as the best means to this end the appointment of a Standing Commission covering all the institutions concerned, and having, through its chairman, ready access to the Prime Minister and the Chancellor of the Exchequer. We propose to deal in separate articles with some of the points raised in this important report. The second part will be devoted to remarks and recommendations applicable to the individual institutions which house the national collections.

On Oct. 16 the Royal Swedish Academy of Science, Stockholm, celebrated the 150th anniversary of the birth of Berzelius, the great chemist. Born on Aug. 29, 1779, a year before Davy, Berzelius graduated at Upsala in 1804, and in 1806 succeeded Spaurnau, professor of medicine, botany, and chemical pharmacy at Stockholm, where the remainder of his life was passed. Of the Academy of Science he became president in 1810; he was made a baron in 1835, and died on Aug. 7, 1848. Distinguished "as an experimenter, as a discoverer, as a critic and interpreter, and as a lawgiver", Berzelius made contributions to every branch of chemical science, and Ramsay once said "that he believed that since the time of Boyle none had done more for the advancement of chemistry than had Berzelius". His kitchen laboratory at Stockholm, in which Dulong, Mitscherlich, Gmelin, Gustav and Heinrich Rose were taught, has been described for us by Wöhler. In the gardens at Stockholm "not far from the statues of the kings, amidst trees, with a fountain playing before it, is the bronze figure of Berzelius, the great chemist. He is enveloped in a thick, heavy mantle, the stoic fur of the philosopher, and the face and the whole pose indicate the union of perseverance and intelligence which belongs to such conquerors in the field of science."

Dr. D. Adamson's presidential address to the Institution of Mechanical Engineers on Oct. 18 was of a somewhat discursive character; the topics he touched upon ranging from examinations to salesmanship; from researches to public affairs. Among the activities of the Institution is that of holding examinations in conjunction with the Board of Education. On the results of these examinations, which are held in many centres, National Certificates are granted, and these in some cases form the first step towards qualification for membership. Speaking of himself as the "one dissentient" in February 1912 when compulsory examination for admission to associate membership was approved by a general meeting of the Institution, Dr. Adamson said he has been much interested in the success of the scheme of National Certificates which has since been developed. "What is wanted now is that the Institution should foster the co-operation of reputable engineering employers and endeavour to include on the National Certificate a record of the holder's practical training in works". Dr. Adamson laid stress on the need of

works experience, which he said "does not necessarily mean the acquisition of skilled craftsmanship, although this is a great asset if it can be achieved, but it does mean acquiring knowledge of commercial limitations". There are almost as many different views on engineering education as there are engineers, but we gather Dr. Adamson thinks the holidays at school and college are unnecessarily long and that the pendulum has swung too far in the direction of academic teaching.

THE increase in the prestige of the Institution to which Dr. Adamson referred is due to many things, not least among which is the support given to research. He recalled the work of Beauchamp Tower on friction and lubrication in 1883, the experiments on riveted joints of 1881, the marine-engine trials of 1889–1894, the steam-jacket research of 1886–1894, the gas-engine research of 1898–1908, the marine oil-engine trials of 1924–1926, and he said that " Researches to be of direct value to any industry must combine correct scientific control with a proper appreciation of commercial limitations and practical requirements ".

WHETHER Dr. Adamson's remarks on public affairs will carry conviction we are doubtful. Many engineers, like many men of science, are too absorbed in their work to devote much time to public activities. He had headed one section of his address " Non-producers ". " The great improvements that have been made in the methods of production", he said, "have increased the number of non-producers without improving the position of the producers. The mechanical engineer has still to work as hard, or harder, than his forefathers, while he sees around him increasing numbers of merchants, distributors, and others who neither toil nor spin. . . ." This division of the community into producers and non-producers, we think, is not justified. Civilisation is a vast and complex organism, and the banker in his office, the clerk at Lloyd's, the commercial traveller, the tradesman, the labourer in the docks, and the typist are as indispensable as the man with the hammer and chisel. There are, it is true, some actual non-producers, but their number is negligible. Dr. Adamson suggested young engineers might well become salesmen; by doing so they would scarcely consider themselves to have become non-producers.

IN its report to council for the year 1928 at the meeting held last February the executive committee of the Association of Scientific Workers expressed the hope that a non-party Parliamentary Science Committee would be created which would be prepared to act as a consultative body on all matters affecting the interests of science and scientific workers. At its meeting held on Oct. 19 the Council was informed that this hope had been fulfilled, the general secretary of the Association, Major Church, having made this his first task on his return to the House of Commons. Now that the Parliamentary Committee has been formed, the Association intends to invite the co-operation of other bodies representative of the scientific interest to make its work effective. The British Science Guild has already expressed its intention to assist, and it is hoped that support will be also forthcoming from the British Association for the Advancement of Science, and possibly the Royal Society. Some of the subjects to which the Parliamentary Science Committee may usefully be asked to give its attention are indicated in the leading article in the present issue. The attention of the Committee will also be directed to another matter with which the Association is concerned: namely, the production, importation, collecting and distribution of cinematograph films of scientific interest, and the modification of certain restrictive censorship regulations. For the information of the Parliamentary Committee, as well as the general body of scientific workers, the executive has requested the research committee of the Association to produce a further report on fundamental research, giving as detailed an account as possible of what researches are in progress, what urgent problems need investigation, and what funds and other facilities are needed for their prosecution.

AMONG the resolutions carried at the council meeting of the Association of Scientific Workers was one deploring the failure of the present Government to appoint direct representatives of the scientific interest on important committees and commissions, as, for example, the Royal Commission on the Civil Service, the Patents Committee, and the Advisory Committee on Colonial Development. The omission of a naturalist from the commission appointed to consider the creation and preservation of National Parks was the subject of executive comment, as well as the failure of the Government to appoint a direct representative of science on the Research Grants Committee of the Empire Marketing Board. The executive also commented on the attitude taken up by the Secretary of State for the Dominions (Lord Passfield) towards anthropological research. Lord Passfield, while acknowledging the importance of this field of research, was not prepared to recommend the appointment of an anthropologist to the Colonial Office or to any of the Colonial Governments.

TWENTY years ago the late Mr. Leon Gaster delivered a series of four Cantor lectures before the Royal Society of Arts upon modern methods of illumination. At the end of this course he announced that a society had been formed to focus interest upon the subject of illumination and to bring into contact engineers, architects, oculists, and others concerned with various aspects of it. This was the beginning of the Illuminating Engineering Society, the first president of which was Prof. Silvanus Thompson. The work of this Society is well known to many readers of NATURE, and frequent reference has been made in these columns to it. Mr. Gaster created the Society; and his devoted services and untiring labours in promoting the scientific study of illuminating engineering should not be allowed to be forgotten. We are glad, therefore, that the council of the Illuminating Engineering Society has decided to institute a Leon Gaster Memorial Fund, the interest on which will be devoted primarily to the establishment of a premium to be awarded annually for the best contribution on any

aspect of illuminating engineering. Subscriptions to this fund are invited and may be sent to the honorary secretary of the Society, Mr. J. S. Dow, 32 Victoria Street, S.W.1.

It is now possible to state that the rainfall over the British Isles as a whole during September 1929 was just less than half the usual amount. During the last sixty years there have been four drier Septembers, of which only those of 1907 and 1910 were appreciably drier and those of 1894 and 1895 were slightly drier. The drought was most intense in the south of England, in the south-east of Scotland, and in the neighbourhood of Dublin, where the total fall amounted to less than a quarter of the average. In parts of Surrey, Hertfordshire, and Buckinghamshire rain fell only on the last two days of the month.

The total rainfall recorded over the British Isles up to the end of September this year was less than that of any similar period in the last sixty years, although there was very little more in 1870, 1887, and 1921. Over England and Wales alone January to September 1929 was drier than any similar period in the last sixty years, the general fall being 15·0 inches compared with 16·7 inches in 1870, 17·0 inches in 1921, and 17·4 inches in 1887. In both 1887 and 1921 the last three months of the year were dry, so that it is by no means certain yet that 1929 will rank as the driest year on record. The relatively wettest parts of England and Wales were the Devon-Cornwall Peninsula, western Wales, and the English Lake District, where the rainfall of the nine months, January to September 1929, was about three-quarters of the average amount. Rather less than half the average was recorded in the neighbourhood of Margate and Skegness, and over a large area stretching from Woburn in Bedfordshire to Southampton. At Oxford the total rainfall (44 per cent of the average) was only about 7·5 inches, or 1·5 inches less than that recorded in the previous driest group of nine months during the last sixty years, namely, February to October 1921.

The *Discovery*, with Sir Douglas Mawson's Antarctic Expedition on board, left Cape Town for the south on Oct. 19. The King sent the following message to Sir Douglas Mawson: "The Queen and I send you and all members of the Expedition our best wishes for your success and for a safe journey." In an outline of his plans, published in the *Times*, Sir Douglas Mawson gives the probable route of the ship. From Cape Town, with a possible call at the Crozets, a course will be set for Kerguelen, where several hundred tons of coal sent from Cardiff will be taken on board. A call will then be made at the volcanic Heard Island, previously visited by the *Challenger* and the *Gauss*. From there the course will be south-east into the pack-ice towards the edge of the continent. If the ice allows, the ship will follow the edge of the land, but in any event a series of oceanographical observations will be made so far south as possible. A small scout aeroplane will assist navigation by reporting on the nature of the pack. Should the *Discovery* reach the coast, small survey parties will be landed for a few days, but no lengthy sledge journeys are contemplated, and it is not proposed to winter if the ship can be extricated from the pack in autumn. It is hoped to reach Australia in April 1930. Capt. J. K. Davis is master, and with a scientific staff of twelve the *Discovery* carries a complement of forty.

There is suggestiveness for the public health authorities of the United States in the results of Raymond Pearl's investigation of the "Biological Factors in Negro Mortality" reprinted from the May number of *Human Biology*. Studies of bodily structure have already shown distinct differences between the negro and white races, and now it is apparent that the differences extend into the realm of susceptibility to disease. The negro reacts differently to diseases in a great many ways, including incidence and distribution of disease amongst the bodily organs. For example, amongst negroes, fatal illnesses due to disease of the alimentary tract and its associated glandular organs are less common than amongst whites. On the other hand, mortality due to lesions of the circulatory system and to the respiratory system forms in each case a greater proportion of the total mortality of the negroes than of whites. These and other results show that in some respects the negro appears to enjoy a greater biological fitness than the white race, while in other respects he is apparently less well adapted to the general environment in which he must live.

A series of Nature reserves has been created in Soviet Russia through the Institute for Natural Science, we learn from a *Daily Science Bulletin* issued by Science Service of Washington, D.C. In the Urals a small park of 55 square miles has been created in a district famous for its variety of precious stones. At Astrakhan, in the Volga district, there is a bird reserve of 88 square miles, and in the Crimea a smaller area has been given over to mouflon and various kinds of deer. A rest station for birds on migration exists in a marshy region midway between the Caspian Sea and the Arctic, the island of Kondo in the White Sea has been set aside for eider duck; but the largest of all the reserves is that in the Caucasus, which extends to about 1097 square miles. The unfortunate thing is that the creation by edict of Nature reserves is a gesture of little real significance unless steps are taken to give the animals in the areas active protection. That this protection is not forthcoming is shown by the fate of the wild bison of the Caucasus reserve, which are thought to have been exterminated by poachers. Furthermore, an active policy of extermination is encouraged by the game laws of 1924, which make it more or less a public duty to kill the larger predatory birds and beasts, some of which are said now to be very rare.

At the opening meeting of the Illuminating Engineering Society on Oct. 8, a report was presented reviewing progress in illumination. Allusion is made to the proceedings at the recent annual conference of the Association of Public Lighting Engineers, to the International Lighthouse Conference, and to the

informal International Aviation Lighting Conference held at Olympia in July. Numerous specifications and reports have been issued. New committees have been formed by the National Illumination Committee to investigate aviation lighting, lighting education, traffic-control signals, and colorimetry. A feature of the past year has been the development of illuminating engineering abroad. A long series of papers was read at the 23rd annual convention of the American Illuminating Engineering Society; other reports and papers have been presented at the annual conference of the Illuminating Engineering Society in Germany and to the Société Française des Électriciens. 'Festivals of Light' have been organised in a number of continental cities, and have led to permanent improvements in lighting conditions. A shop-lighting contest organised in Milan also proved very successful, though the taxes imposed on lamps and on current used for lighting in Italy constitute a grave drawback. Preparations are now being made for the next International Illumination Congress which is to be held in Great Britain in 1931.

WE learn from the *Record of the Bell Laboratories* that work has been commenced on the development of a deep-sea telephone system between London and New York. It is expected that the cable will be completed before the end of 1932. It gives only a single telephone circuit, but this will be a most trustworthy one, free from the variability and disturbing noises of a radio circuit. It is not intended that this line should compete with radio circuits; it will supplement them. The attenuation of the voice signals will be much greater than that permissible on telegraph cables. This is made possible by using a sheath made from one of the alloys called 'perminvars', which are composed mainly of nickel, cobalt, and iron. They are characterised by high electrical resistivity, and their magnetic permeability is practically constant over a wide range of magnetizing forces. The conductor is insulated by 'paragutta', a composite material giving much better insulation than gutta percha. The losses are so low that a very high sending level can be used for the signals and, as there is practically no interference, a very low receiving level can be employed. The route of the cable is not yet completely settled, but it is probable that the main trans-Atlantic link will extend directly from Newfoundland to Ireland, a cable length of approximately 1800 nautical miles. From Newfoundland it is expected that the circuit will be carried through several sections of submarine cable through Nova Scotia, New Brunswick, and the New England States to New York City, where it will terminate. From Ireland the circuit will probably be carried through submarine cables to Scotland, and thence by land cable to London, the other terminal.

THE Council of the Royal Meteorological Society has awarded the Symons gold medal for 1930 to Dr. G. C. Simpson, director of the Meteorological Office, Air Ministry. The medal is awarded for distinguished work in connexion with meteorological science, and will be presented at the annual general meeting on Jan. 15 next.

THE Kelvin medal of the Institution of Civil Engineers has been awarded to M. André Blondel of France. The presentation of the medal will be made by Sir Donald Macalister of Tarbert, Bart., in the Great Hall of the Institution on Tuesday, Nov. 5, at 5 P.M. His Excellency the French Ambassador will receive the medal on behalf of M. Blondel, whose health does not permit him to travel to London. Sir Brodie H. Henderson, president of the Institution, chairman of the award committee, will take the chair.

AT the end of last session the Society of Glass Technology decided to form a London section of the society. This section began its activities on Oct. 2, when its first meeting was held at the offices of Messrs. Holophane, Ltd., Westminster. In a general discussion on the possible activities of the section it was suggested that the main object of the meetings should be to provide opportunities for the free discussion of matters of practical interest. It was emphasised that the activities of the section should include, in addition to matters primarily of interest to the glass industry, those of interest to closely allied industries in which glass is an important raw material, such as the manufacture of electric lamps, wireless valves, thermometers, hydrometers, scientific glassware, mirrors, etc. A representative council of the London Section was formed to act as an executive committee, and consists of officers of the Society resident in the London district and London members elected at the meeting. Mr. Verney Stott, of the National Physical Laboratory, Teddington, Middlesex, was elected honorary secretary of the section. The next meeting will be held at 7.30 P.M. on Wednesday, Nov. 6, at the Osram G.E.C. Glass Works, North Wembley.

THE value of charts in the study of the development of sciences is well recognised, and Dr. Joseph Needham, of the Biochemical Laboratory, Tennis Court Road, Cambridge, has produced an excellent chart, $6\frac{1}{2}$ ft. × 3 ft., by lithography, which will be found very useful in studying the development of biochemistry and physiology and, for the earlier periods, of general biology. It may be obtained from Dr. Needham, price 10*s*. 6*d*. The chart gives the dates of the principal investigators, short descriptions of their books or memoirs, and interesting quotations and notes. The time scale starts at 1450, but the earlier period is briefly referred to. The whole forms a very interesting survey of the subject, and should prove very useful to students.

MESSRS. Murby and Co. have recently added to their Geological List two series of "Patterns for the Construction of Block Models" prepared by Dr. F. Smithson. These may be pasted on card, cut out, and made up into hollow blocks; or they may be mounted directly on cardboard blocks supplied by the publishers to the required size (3 in. × 2 in. × 1 in.). Solid wooden blocks, it may be added, would be better still, especially for class use. The models should prove useful to students of geology and physical geography, helping them to visualise structures from every angle, and so to gain the experience necessary to read geological maps intelligently. The first series

(12 models) illustrates faults in horizontal and tilted strata; folded strata; faults in folded strata; and unconformity. The second series (14 models) illustrates folds, overthrusts, and igneous intrusions. The patterns are clearly printed in a standard system of shading and numbering, and the paper used is well adapted for taking colours. The price is 1*s.* 6*d.* per set, and cardboard blocks are supplied at 1*s.* 6*d.* per dozen. The publishers can also supply the models ready made up, either plain or hand-coloured.

Applications are invited for the following appointments, on or before the dates mentioned:—A whole-time Principal of the Woolwich Commercial Evening Institute, Plumstead—The Education Officer (T.7), County Hall, Westminster Bridge, S.E.1 (Oct. 28). A lecturer in mathematics at the Exeter Diocesan College for Schoolmasters—The Principal, Saint Luke's College, Exeter (Oct. 30). A lecturer and/or demonstrator in rubber technology and rubber workshop practice at the Newton Heath Technical School, Manchester—The Director of Education, Education Offices, Deansgate, Manchester (Oct. 31). An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Office, Rowe Street, Plymouth (Nov. 1). A science master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (Nov. 1). An assistant lecturer in physical chemistry in the University of Bristol—The Secretary, University, Bristol (Nov. 4). A lecturer in natural and agricultural sciences at Harrison College, Barbados—C.A. (N), The Secretary, Board of Education, Whitehall, S.W.1; Scottish candidates, C.A. (N), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Nov. 11). A George Henry Lewes student in physiology in the University of Cambridge—Prof. Barcroft, Physiology School, Cambridge (Nov. 15). A Foulerton research student to conduct researches in medicine or the contributory sciences—The Assistant Secretary of the Royal Society, Burlington House, W.1 (Dec. 9). A cancer research fellow in the Department of Experimental Pathology and Cancer Research, University of Leeds—The Clerk to the Senate, The University, Leeds. A male junior assistant at the Chemical Warfare Research Department of the War Office—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. An assistant lecturer in mathematics at the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11.

Our Astronomical Column.

The New Telescope for Edinburgh Observatory.—In *Engineering* for Sept. 6 and 20, and Oct. 4 and 18, is a description of the 36-in. reflecting telescope for Edinburgh Observatory, made by Messrs. Sir Howard Grubb, Parsons and Co., to the specifications of Prof. R. A. Sampson, Astronomer Royal for Scotland. The article is accompanied by some fifty illustrations, many of them from working drawings, and with their aid it is possible to understand the construction of all the principal parts. The optical system is arranged on the Cassegrain principle, the main mirror being 36 in. in diameter, with a focal length of 15 ft. The Cassegrain mirror mounted near the upper end of the tube is 10 in. in diameter and is designed to give an equivalent focal length of 54 ft. in conjunction with the main mirror. The mounting is of the equatorial type, and the illustrations include sections through both polar and declination axes and the methods of driving and controlling the instrument.

The spectrograph to be used with the telescope has been made by Messrs. Adam Hilger, Ltd. Either one, two, or three glass prisms or one quartz prism can be used, and these, together with the three cameras, are carried in a single-piece aluminium casting lined with felt and kept at a uniform temperature by electric heating wires.

Special attention is directed to the very extensive use made of ball bearings for both polar and declination axes and many other parts. In 1888, 1904, and 1916 respectively, *Engineering* fully described the 36-in. telescope of the Lick Observatory, the 40-in. refractor at the Yerkes Observatory, and the 72-in. reflector for the Canadian Government. These three instruments were constructed by Messrs. Warner and Swasey of Chicago. Of Mr. Warner there is an obituary notice in *Engineering* of Sept. 20.

The Satellites of Mars.—The two tiny bodies that revolve close to Mars afford an example of an interesting kind of motion. Our moon is so far from the earth that the sun's disturbing action is far more potent than the effect of the earth's equatorial protuberance; the result is that the pole of the moon's orbit plane goes round a centre that is sensibly the pole of the ecliptic; on the other hand, in Neptune's system the sun's disturbing action is infinitesimal, and the pole of the satellite's orbit goes round Neptune's pole of rotation. In Mars we have an intermediate state of things; the poles of the satellites' orbits go round points between the poles of the planet's rotation and revolution. The pole of the orbit of Phobos describes a circle with radius 1·1° in a period of 2·264 years. In the case of Deimos the radius is 1·77°, the period 56·127 years.

H. Struve made two careful investigations of the positions of the centres of these circles and of the pole of Mars; the first was made about 1894, the second about 1909; as twenty more years have now passed, and numerous observations of the satellites have been made at Lick, Yerkes, and Washington, Mr. H. E. Burton, of Washington Observatory, has made a new discussion in *Astr. Journ.*, 929, of the whole series of forty-nine years. The point that is of most interest to Martian observers is the position of the planet's axis; there has been much discussion as to whether this is best determined from the satellites or from markings on the disc. Mr. Marth adopted Struve's 1894 result from the satellites, but afterwards the ephemerides went back to a value derived by Lowell and others from markings on the disc. There is no question that the various determinations from the satellites agree excellently *inter se*, and it is difficult to think that they can be wrong by as much as a degree. Burton's position of Mars' north pole is R.A. 316·99°, N.Decl. 52·51° (equinox of 1880); this gives 25·20° for the obliquity of Mars' equator to its orbit, which is just 2° larger than Lowell's value. From past experience, however, it is unlikely that the observers will accept a value derived from the satellites.

Research Items.

Beakers from the Isle of Skye.—In *Man* for October, Mr. W. Lindsay Scott figures and describes two beakers discovered in the recent excavation of a cairn at Kraiknish, Loch Eynort, Isle of Skye. The cairn is circular and now some 27 ft. in diameter and 4 ft. in height. The cover stone, which has been laid bare, is of irregular shape, measuring 5 ft. 6 in. in length, 3 ft. in breadth, and 1 ft. in thickness. There are no traces of an entrance. The chamber was found to be filled with earth and stones to within 15 in. of the cover stone. The contents consisted of several distinct layers of material—bones brought in by crows, peaty earth, blackened and burned matter also containing charcoal, and red-brown earth. The floor was practically covered with water-worn pebbles which also occurred throughout the layers. In the lowest layer were found fragments of one of the beakers, which has now been reconstructed, a second beaker complete except for a hole in the upper surface, and a tiny flint button scraper. No traces of human bones were found. The second beaker was tightly wedged in with water-worn pebbles around and below it. Beaker *A* is of thick gritty paste, light brown with black core, flat base, tall, slightly rounded body, faintly constricted neck, and short upright rim with lip bevelled inside. The whole of the exterior is ornamented with a broad belt of irregular chevrons, with narrow cross-hatched zones on neck and shoulder separated by bands of horizontal lines. Beaker *B* is of similar paste, but the exterior is of a darker brown and the interior blackened on one side. It has a flat base with a distinct foot. The body is short and rounded with a constricted neck. It is ornamented on the body and rim by broad zones of open lozenge pattern. The lower zone has no margin below and finishes in short double strokes hanging vertically. When completely excavated the chamber was found to be pentagonal and formed of six vertical slabs at a height of about 2 ft. from the floor. The floor was composed of small slabs of irregular shape neatly fitted together.

Archæology of Disease in South America.—A well-illustrated article by Prof. Roy L. Moodie in the *Scientific Monthly* for September reviews the evidence bearing upon the antiquity of disease in South America afforded by archæology. The most important source is the mummies. Those which still remain in the mummy packs have been examined by X-rays. Of those which have been unwrapped, some have been soaked in a weak solution of formalin, and it has then been possible to identify muscles, nerves, tendons, arteries, and other organs microscopically, and even to find evidence of disease in the walls of the arteries. Pottery jars representing part or the whole of the human form have furnished evidence of the disease known as *uta*, a loathsome affliction of the mouth and nose due to a blood parasite. The effects of this disease are shown in a skull which has been discovered. The evenness of the wound suggests that a surgeon may have attempted to arrest it by excision of the diseased part with an obsidian flake. The skin disease Veruga Peruana and a rare disease *goundou* are also shown. In the mummies of children, which by their number suggest a heavy mortality, few diseases have left traces on the bones. Rickets did not exist. The nutritional disease osteoporosis, which leaves its effect in paired lesions of the roof of the orbit or bones of the cranial vault, is found, while several specimens suggest hydrocephalus. There are numerous instances of tumours, mostly of the benign type. Bony tumours of huge growth due to irritation from tumours in the brain membranes are sometimes found. Of dental troubles there are a variety. Caries are not so prevalent as pyorrhea. Abscesses are common, often of enormous proportions. Accidental injuries and wounds are common, especially in the highlands. Some produced by a heavy mace were immediately fatal. Broken limb-bones were crudely set. Most surgical practice was restricted to the head. Trephining was commonly followed, heat being applied as a counter irritant.

The Food of Birds.—In a letter to NATURE (Oct. 12, p. 577), Prof. Poulton shows that inaccurate conclusions as to the diet of birds may follow upon the sort of examination ordinarily made of stomach contents. That deductions drawn from the cast-up pellets of owls and hawks may be equally untrustworthy is shown by Allan Brooks in the *Canadian Field Naturalist* (October 1929, p. 160). The difficulty here is that the pellets are limited to certain elements of the food. Only where fur or other absolutely indigestible matter is swallowed is any pellet thrown up. But give a hawk or owl a bird that it can pick or strip the skin from, flesh only is eaten, and no evidence of this item of diet appears in the pellet unless it be accidentally involved in mammal's fur. An experiment made with snowy owls seems to prove the point. A number of these birds when shot had in their stomachs only mice, although they were shot in the act of killing ducks. This suggested the experimental feeding of captive owls on birds, and it was found that the skin and feathers were first torn away, and that only flesh, without even bones, was eaten. On the other hand, in the case of mice, skin, bones, and fur were swallowed; so that while the mice were readily distinguishable in the stomach, the flesh of the birds was not. It was also noticed that the captive owls ejected pellets only when mice were swallowed or when indigestible matter was forcibly fed to them.

The Wool of Domesticated Sheep.—In recent years the development of apparatus by which wool can be minutely measured has given a stimulus to the investigation of wool qualities as indicating the relationship of domesticated breeds of sheep. In a lengthy paper B. Kaczkowski has recorded the results of his application of this method to the races of Polish sheep (*Bull. internat. Acad. Polonaise Sci. u. Lettres*, 1929, p. 521). He discusses the classificatory value of the composition of the fleece as regards the relative proportions of the long, rough, medullated hairs of the original outer coat, and the finer, non-medullated hairs of the under coat of wool. As a result he divides the Polish races of sheep into three groups. The first contains the most primitive, original domesticated races, in which the outer hairy coat tends to predominate in amount and length; the second includes more highly bred and transitional races differing distinctly from the primitive forms; and a third group shows still more clearly the results of breeding and selection in the predominance of fine wool and reduction of medullated hairs.

Behaviour of Sponge Cells.—Mr. M. W. de Laubenfels in an interesting note describes experiments with sponge cells of different species, made by mixing two of these together (Year Book No. 27 of the Carnegie Institution of Washington, 1928. Tortugas Laboratory). Three as yet undescribed sponges were used, which he designates the red, green, and purple species. Two species were conglomerated together by cutting

portions of the adult into small bits and mixing in a bolting cloth bag, both being expressed simultaneously. The red-green conglomeration settles in masses of a few score cells and remains inactive until death sets in in a few hours. The green-purple conglomeration behaves in a manner which is closely similar to the monospecific culture but with characteristics halfway between those of the green and the purple, but metamorphosing more slowly than either, and the cells of the two species gradually sort themselves into separate masses. The red-purple conglomerations are formed before settling and have a characteristically flocculent appearance, persisting throughout their life of only about a week; they make a feeble attachment to glass and develop flagellate chambers. If cells separately expressed are mixed they form aggregates of cells of their own species only. Aqueous extracts of the separate species were made and separately added to each of the others with the curious result that the red and the green were most inimical to one another and yet are of the same genus, whilst the purple, of a different family, damaged neither of the others. Heating the extracts caused them to lose their effect. Similar experiments were made with other sponges, the commercial sponge *Euspongia officinalis* proving unsuitable, but a Halichondria was nearly as good as the original forms used, and conglomerations were secured.

Lampreys and their Ways.—Under this title there is an exceedingly interesting article by Prof. Simon Henry Gage in the *Scientific Monthly* for May (Science Press, Lancaster, Pa.). Not only is it a good survey relating to the general knowledge of the group, but the author also includes much of his own personal observation. Directly the larval metamorphosis is over (no food being taken during the process, which may last for four or five months) the young lampreys pounce on any fish available, even attacking large pike. Their food is the blood of the fish attacked, and there are special glands near the neck of the lamprey which secrete a fluid to prevent blood-clotting. By measuring the capacity of the intestine of a full-grown lamprey it was estimated that 25 c.c. of blood could be taken at one meal, a satisfactory meal lasting about a month. After that time attachment for several days would be made to another fish and a fresh meal taken. All lampreys lay their eggs in freshwater streams, those from ocean and lake often overcoming enormous obstacles in order to reach suitable places, sometimes swimming hundreds of miles. The adults, probably three or four years old, die after depositing their eggs and do not return to lake or ocean. The larvæ, or ammocœtes, are plankton feeders, but it was found that they were capable of digesting milk, having a digestive ferment serving the same purpose as the serum in mammals. The article is well illustrated and is altogether worth reading.

A New Squid.—Mr. S. Stillman Berry describes a new squid which is peculiar in the male having both ventral arms modified sexually ("*Loliolopsis chiroctes*, a new Genus and Species of Squid from the Gulf of California." *Trans. San Diego Soc. Nat. Hist.*, vol. v., No. 18, 1929). In several other respects it differs from the other genera of the family Loliginidæ and the organisation of the left ventral arm with its peculiar comb-like structure is unique. These squids were collected by Mr. Tom Craig, who found them swarming round the light in schools of several hundred. A detailed description of the external anatomy and of the mouth parts are given, and beautiful illustrations accompany the paper.

Plankton of the Tyne Estuary.—In the *Proceedings of the Durham Philosophical Society* (vol. 8, pt. 1, 1928), Miss O. M. Jorgensen describes plankton samples from the tidal region of the River Tyne made for the purpose of studying the conditions of the river with regard to pollution. Two series of samples were taken, from the region of the Black Middens up to Newburn Suspension Bridge, a distance of fifteen miles up the river, and from the region of the Swing Bridge, Newcastle-upon-Tyne. These are compared with tidal conditions in the River Coquet as free from pollution, where it was found that with the exception of one estuarine mysid and one larval psychodid, the planktonic species were all marine (36), the number of species and individuals, consisting chiefly of Copepods with a small number of diatoms and peridinians, varying with the state of the tide. The outstanding fact brought out is the large quantities of marine organisms carried up the Coquet estuary at a certain rate by the flood tide which are driven back again during the ebb with increased rapidity, the latter due to the stronger current produced by the combined effect of tide and river. On the other hand, the numbers of species and individuals in the Tyne were comparatively small, also consisting of copepods, diatoms, and peridinians. The commonest copepod in the Coquet was the marine *Temora longicornis*, whilst in the Tyne it was replaced by the closely allied *Eurytemora hirundoides* which is a more estuarine form, and this species does not occur lower down the river than about three miles from its mouth. Of marine species only diatoms and peridinians seem to be able to survive along the whole reach of the polluted estuary, and only firmly established estuarine forms are able to withstand the adverse conditions. Even Eurytemora, which has a tremendous power of resistance, is very susceptible to a low percentage of oxygen and a temperature increase, and the same may be said for Neomysis. The presence in the Tyne estuary plankton of the littoral enchytræid *Lumbricillus lineatus* is interesting and probably to be accounted for by dredging operations further up the river.

Crab-marking.—The Fishery Board for Scotland has published a paper entitled "Crab Marking Experiments, September 1916 to February 1924" (*Scientific Investigations*, 1928, No. 4; 1929), which contains tables and diagrams embodying records of crab-marking experiments carried out under the supervision of Dr. H. C. Williamson by the Fishery Board for Scotland on the east coast, from September 1916 until February 1924, and the data relating to specimens from the experiments prior to 1927. 2819 crabs were marked and liberated, and of these 201 (7·1 per cent) have been recovered. A series of small charts shows the approximate positions of those recaptured ten miles or more from the place of liberation and days of freedom. The largest number recaptured from any one experiment was 25 out of 139 crabs liberated off Burnmouth in 13-15 fathoms, one of which had 650 days of freedom and was recaptured to the east of North Sunderland; another having 530 days of freedom was captured to the north-east of Berwick. Several others from the same experiment were captured after 300 days or more. The longest time before capture for any crab was 1493 days, released one and a half miles north of Portsay in 23 fathoms, a distance of well over 90 miles from the place of release. Four others had over 1000 days of freedom, the other periods varying from 2 to 900 days. Although the breadth of the crabs when liberated is given, there are no measurements after recapture, but details of condition of

shell and sex organs are shown. Berried crabs with pink or red ovaries (immature to nearly ripe) were recovered from depths varying from 3 fathoms to 40 fathoms.

True Endoskeleton in Insecta.—What little research has been done on the endoskeleton of insects has been chiefly on the internal structure of the head and thorax. The endoskeletal structures have hitherto been regarded as chitinised invaginations of the exoskeleton and are known as apodemes. That is to say, there is no true endoskeleton in the Insecta. In this connexion it is of some interest to note the recent discovery by Mr. S. Maulik (*Proc. Zool. Soc. London*, **2**, pp. 305-308; 1929) of a very curious endoskeletal structure in the hind femur of Halticine beetles which appears to arise independently of the exoskeleton. This structure consists of a strongly chitinised curved plate with a narrow end which is hinged to the tibia, and a broad end along the edge of which is attached a strong femoral abductor muscle. The curvature usually occurs close to the attachment of the muscle, so that the organ apparently acts as a lever, a slight contraction of the muscle magnifying the movement of the tibia, and so enabling an extremely rapid flexion of the tibia. The jumping power of these insects is very great, but not greater than in many other insects. It is therefore interesting to note that the author has failed to discover any similar structure in such well-known saltatorial groups as the grasshoppers, fleas, and froghoppers. Mr. Maulik regards the structure as having arisen by the chitinisation of the abductor tendon. A point of importance to systematists is that this structure affords a sure means of distinguishing Halticine beetles, which previously have been frequently confused with certain Galerucinæ, particularly those with inflated hind femora. It is also of interest to know that certain Halticinæ, such as the poisonous beetle of the Kalahari Desert, although they do not jump, possess this structure in a degenerate condition.

Geology of Southern Rhodesia.—A particularly valuable publication to those interested in the comparative geology of Africa is H. B. Maufe's "Outline of the Geology of Southern Rhodesia" now issued in its second edition as *Short Report No. 24* of the Geological Survey of Southern Rhodesia. It contains not only an excellent coloured geological map (1/3M), with more detail than appeared in the first edition, but also a layer-coloured topographical map to the same scale. The chief difference in the tabulated scheme of geological history is that the epoch of intrusion of the Great Norite Dyke is now placed between the Lomagundi System (regarded as equivalent to the Transvaal system) and the Umkondo system (probably equivalent to the Waterberg). This makes the Great Dyke approximately contemporaneous with the Bushveld complex, which has now been proved to be pre-Waterberg in age. Similar summary reports from other Colonial surveys would be extremely welcome to those who have little time to follow the unfamiliar details of longer memoirs confined to local areas.

The Auroral Spectrum.—The spectrum of the aurora shows conclusively that the upper atmosphere contains both molecular nitrogen and atomic oxygen, and according to a letter appearing in *Die Naturwissenschaften* for Oct. 11, from V. M. Slipher and L. A. Sommer, of the Lowell Observatory, it appears now that atomic nitrogen is also almost certainly present. Spectra of the aurora, obtained by these observers with a fast instrument, show a line in the green at 5206 A., which is coincident within the limit of accuracy of their measurements with a 'forbidden' line in the arc spectrum of nitrogen, the wave-length of which can be predicted from recent analyses of the latter based on laboratory data. The energy required to produce the metastable nitrogen atoms from which this line originates is 2·37 electron-volts, and it seems not unlikely that it will prove possible to excite this forbidden line in discharge tubes in much the same way as the forbidden green oxygen auroral line at 5577 A. Some earlier investigators of the aurora have recorded a line at a wave-length a little greater than 5000 A., but their measurements have been generally inaccurate and inconsistent, and it is of course only in the last few years that it would have been possible to say from which element it arose, even if its existence had been established beyond doubt.

Colloidal Gold.—Prof. P. P. von Weimarn, in the *Japanese Journal of Chemistry*, vol. 3, No. 4, gives a long description of the preparation of red solutions of colloidal gold, which contains some interesting results. He shows that it is not necessary to use reagents of extreme purity (as recommended by Zsigmondy). However, the higher the degree of purity the higher is the concentration which can be reached, by evaporation, without the change of colour from red to violet and blue taking place. The solutions are prepared by reducing chlorauric acid by alkaline formaldehyde, and precise directions are furnished. A number of quotations from authors who failed to prepare the red solution by Zsigmondy's method are given. Weimarn concludes from these, and his own experiments, that "perfectly transparent and absolutely non-turbid solutions of purely red colour" are formed "only when there are left traces of unreduced gold compounds", probably AuOH. To obtain solutions of exactly reproducible properties, however, it appears to be necessary to work in gold or platinum vessels, preferably conical beakers, with freshly redistilled formaldehyde, and extra pure water and reagents.

Electric Power in Japan.—Practically all the electric power required for the Tokyo and Yokohama districts in Japan is supplied by the Tokyo Electric Company. We learn from the *Westinghouse International* for October that the number of its consumers is now well above two million, which is greater than that supplied by any other company. If we rate it by the bulk of the energy supplied it comes fifth in the world's list, three companies in the United States and one in Canada having a larger output. Its chief source of power for delivery in Tokyo is from the hydroelectric installations located in neighbouring watersheds. As the amount of hydraulic power available varies appreciably at different periods of the year, it was found necessary to install a steam reserve plant in the city of Tokyo. Most of this reserve plant would normally lie idle for about eight months of the year. The Japanese, however, have found a use for the electric generator part of their turbo-alternators during the slack periods. The generators are disconnected from the set. They are then run as synchronous motors without any load, their magnetic fields being strongly excited. In this case they act in a similar way to very large electrostatic condensers. An important result is that they bring the supply pressure and the load more nearly into phase with one another. This has the effect of diminishing the supply current although the load remains constant, and also makes all the power generators run more smoothly in parallel with one another. Special machines called rotary condensers are often used for this purpose, but this method of using reserve plant is novel and is to be commended.

The University of Liverpool.

Opening of the Lady Herdman Geological Laboratories.

On Monday, Oct. 21, the Rt. Hon. Stanley Baldwin formally opened the new geological laboratories of the University of Liverpool. The building is a memorial to the late Lady Herdman, who, jointly with her husband, Sir William Herdman, Derby professor of natural history in the University from 1881 to 1920, founded the chair of geology. On her untimely death in 1922, Sir William Herdman added to his earlier munificent gifts to the University a sum of £20,000 towards the cost of new geological laboratories. The generosity of his family and of other friends in Liverpool provided the further funds necessary to enable the scheme he had in mind to be completed.

The new building has a frontage of 97 ft. on Brownlow Street (Fig. 1) and consists of four storeys. An entrance hall occupies the centre of the ground floor and contains on its south wall a bronze memorial tablet to the late Lady Herdman. Also on the ground floor are the professor's room, private laboratory, secretary's room, etc., as well as a large rock-cutting room and laboratory assistants' room, all of which lie on the northern side of the entrance hall, while on the southern side are a map room, research rooms, and a lecturer's room. One of these research rooms is specially fitted for rock-analysis and chemical work. The map room serves as a drawing office and is, moreover, equipped for use as a subsidiary lecture-room. On the first floor is a similar central hall to that below, flanked on one side by a spacious library and on the other by the lecture theatre. The library, 50 ft. in length by 30 ft. in width, is fitted in dark oak, and has accommodation for 20,000 volumes in bays around the walls. Centre tables allow more than thirty students to read in comfort. The lecture theatre is also furnished in dark oak, and accommodates rather more than a hundred students. It is equipped with lantern screens and map screens in duplicate, so that the epidiascope (with micro-projector) and an additional lantern may be in use at the same time. Adjoining the lecture theatre are a preparation room and a lecturer's room.

On the second floor the central area is occupied by the museum, with a balcony surrounding its upper part. Lighting from both top and sides can be adjusted. North and south of the museum are large laboratories, each 50 ft. by 30 ft., for petrological and palæontological work respectively. These rooms are well lit by large windows, in part of plate-glass.

Photo by [*Stewart Bale.*

Fig. 1.

The flat roof is specially strengthened in order that it may take a further storey if and when required.

On the lower ground floor are the library and other storerooms, cloak-rooms, and two optical laboratories. Like all the laboratories in the building, the optical rooms can be completely darkened. They are fitted for goniometry, optical mineralogy, and photomicrography. One of them gives access to a good-sized photographic dark-room. In a constant temperature chamber in the central hall of the lower ground floor is a concrete block designed to support earthquake-recording apparatus. This is sunk into the solid rock-foundation and is free from any direct connexion with the building.

In appearance, whether viewed from within or without, the building is pleasing. Critics will find nothing to offend their æsthetic sense; admirers would simply describe it as beautiful; but both would be impressed by its freedom from any trace of subordination of scientific requirements to internal or external appearance. This is an achievement on which the architects (Messrs. Briggs and Thornely, of Liverpool) are to be congratulated. Those who will have the opportunity of working in the building will find in their surroundings a real expression of the University's motto: *Haec otia studia fovent.*

Mr. Baldwin, before declaring the building open, spoke of the wide field of interest that presented itself to students of geology. As an example of the growing interest in the subject at Liverpool, he mentioned that the Workers' Educational Association had recently asked that an evening class in this subject should be established. After commenting on the relationship between geology and allied subjects, he referred to the increasing importance of experimental geology. Mr. Baldwin laid special stress on the practical side of geology, a side on which the Liverpool school is particularly well equipped. He expressed his pleasure in opening a department that would take its part in training men to spread the knowledge of geological science and promoting the development of the great country from which they sprang.

The opening ceremony was preceded by a largely attended meeting in the main University buildings, presided over by the Chancellor, the Rt. Hon. the Earl of Derby, K.G. He was supported by a number of distinguished visitors, including the Lord Mayor of Liverpool, the Mayors of Birkenhead, Wallasey, and Bootle, and many leading British geologists.

Stability of the Value of Gold.

IN a paper on "The Problem of the Future Value of Gold", read before Section F (Economic Science and Statistics) of the British Association during the meeting at Cape Town, Mr. D. T. Jack stated that the general return to gold standard conditions within the last five years has again directed attention to the problem of stability in the value of gold over long periods.

The general problem of monetary reconstruction presents three distinct phases. The first is the cessation of inflation, the second involves the various readjustments consequent upon stabilisation, and the third and present phase involves the long period problem of the stability of the value of gold. The difficulties which arise from unstable price levels are now generally recognised. They generate artificial stimuli and checks to trade and industry; they make for industrial friction, and they alter the real terms of long-dated debts. To Great Britain, a rise in the value of gold would be particularly detrimental, since it would restrict the recovery of British trade, more especially in view of the high proportion of overseas trade to total trade and the peculiar sensitiveness of international trade to a falling price level. It would increase the real burden of the national debt still further, while the necessity of deflating money costs of production would undermine the recent progress which has been made in negotiating satisfactory wage settlements.

The future value of gold is naturally governed by the conditions of demand for, and the supply of, gold. The world's gold production increased from 69 millions sterling in 1920 to 83½ millions sterling in 1928, but it is still about 12 per cent below the 1913 level. In considering the probable future production of gold, it is necessary to allow for further technical improvements in mining which may make profitable the fuller utilisation of low-grade ores. There is also the consideration that gold production would receive a certain stimulus from an increase in the value of the metal. With regard to the Transvaal, taxation and transport charges are factors of some special importance.

More important factors in the position, however, arise from the side of demand rather than from the side of supply. Since the War, gold has not generally been restored into general circulation, and the widespread adoption of gold-exchange standard principles has made possible important economies in the monetary use of gold. It is important that full advantage should be taken of such economies now possible in the monetary use of gold. Among other things, that means that the reserve requirements of central banks should be restricted. It is necessary also to distinguish the free or effective gold reserves of central banks from the other part, which is immobilised as the minimum legal reserve against the ordinary internal note circulations. At the beginning of 1929, only 35 per cent of the total gold holdings of the central banks of England, France, Germany, and the United States consisted of free or effective gold reserves. There has been a tendency also for certain European central banks to convert part of their reserves in foreign balances into gold for withdrawal to their own vaults, and the danger is that the countries in which these balances are held may find that the demands are so large that they are driven in self-protection to raise their discount rates. For these reasons, central bank co-operation in the use of gold reserves is essentially desirable.

The recent proposals for the establishment of an international bank, if carried into effect, may further this co-operation and in that way will assist in the attempt to prevent any marked appreciation in the value of gold. But the specific proposal raises many difficulties. It is improbable that central banks would sacrifice their individual gold reserves to the management of any international institution. On the other hand, such an institution would facilitate co-operation in connexion with the payment of reparations, and that co-operation, if wisely and cautiously followed, might materially assist in the working out of a closer collaboration in connexion with international gold movements.

Work of the Government Chemist.

TO those familiar with the intricacies of British law in so far as it demands the services of the chemist, and familiar also with the numerous kinds of chemical inquiry necessary for the proper functioning of the government departments, the Report of the Government Chemist upon the work of the Government Laboratory for the year ending Mar. 31, 1929 (London: H.M. Stationery Office, 1*s.* 6*d.* net), will prove both informative and suggestive. The work is of the most varied character, and the responsibilities are of the most diverse, whilst the list of 'other activities' of the Government Chemist, the Deputy Government Chemist, and other members of the staff affords ample evidence both of the importance of the laboratory in State and scientific affairs, and of the progressive spirit which pervades it.

Included in the report are statements which immediately arrest the attention of the general scientific reader. It is, for example, of interest to note that 37 samples of home-grown leaf tobacco, which is being experimentally cultivated in East Anglia and the south of England, were examined, and that of 32 samples of herb beer, ginger beer, etc., 14 contained alcohol ranging from 2 to 7 per cent of proof spirit. A sample of honey purporting to be of British origin was shown, by the character of the pollen grains, to be foreign produce.

The investigations carried out by the laboratory are by no means confined to questions affecting the revenue, to matters involving the possibility of legal process, or to specifications for contracts. Thus, fifty-four samples of river water, muds, and effluents were examined to ascertain the condition of fishing streams from the point of view of fish life, and the effect of certain types of pollution, including that by road drainage, on fish and fish food. Further attention has also been given to the phenomenon of diurnal variation in the quantity of dissolved oxygen in rivers. Moreover, sea-water samples have been examined in connexion with a scheme of oceanic research carried out by the Ministry of Agriculture and Fisheries, and the Fishery Board for Scotland, acting in concert with the International Council for the Exploration of the Sea, in order that accurate data may be available for hydrographers and biologists.

It is also reported that examination of a material obtained during excavation at Rievaulx Abbey proved the substance to be spent oak bark, suggesting that part of the abbey building may at some period have been used as a tannery. A number of samples

of wood and wood preservatives have been examined in connexion with experiments on the preservation of timber carried out by the Forest Products Research Laboratory, whilst methods for determining sulphur impurities in the atmosphere and dust in the air of rooms have been worked out. Seventy-three documents, to which were affixed a large number of stamps, were examined and reported on in connexion with the fraudulent use of stamps, and numerous alterations were detected in betting books required for the assessment of betting duty, the original entries being ascertained in many cases.

Two passages from the Report relating to imported dairy produce may be quoted without comment: "*Cheese*. . . . The results indicate that 50 per cent of the samples had been prepared from whole milk; 23 per cent from milk containing from three-quarters to the whole of its fat; 10 per cent from milk containing from one-half to three-quarters of its fat; and the remaining 17 per cent from milk containing from one-quarter to one-half of its fat. As, however, there are no regulations relating to the marking of skimmed or partially skimmed milk cheese, no exception could be taken to any of the importations." "*Cream*. . . . The samples could be classified into two main groups—one group of samples containing from 48 to 62 per cent of fat, and the other group from 18 to 30 per cent. Two samples, however, contained only 11·9 and 12·9 per cent respectively. There is no standard for cream in this country, and no exception could be taken to the samples on account of low proportion of fat."

General Paralysis and Malaria.

THE Board of Control has issued a report[1] on the treatment of general paralysis by induced malaria, the most outstanding development in psychiatry of the last ten years. For the better appreciation of this important subject, Sir Hubert Bond has written in the form of a preface a historical review of the disease, based on Prof. G. M. Robertson's account. The report itself is by Surgeon Rear-Admiral Meagher, and is the result of his investigations of certified cases admitted to county, district, and county borough mental hospitals in Great Britain between July 1922 and July 1927.

The results of treatment during the years 1922–1924 are the most valuable, the three to five year interval allowing a more accurate estimation to be made than in the case of subsequent years. The cases treated prior to the end of 1924 numbered 438; the results as ascertained at the end of 1927 were that 43·6 per cent were dead, 31·7 per cent remained in hospital, and 24·7 per cent were at liberty. A similar survey of 1173 patients certified during 1923 and 1924 and not treated by malaria showed that 86·6 per cent died, 10 per cent remained in hospital, and 3·4 per cent were discharged. The mental and physical state of those remaining in hospital was found to be much better in treated cases than in untreated.

After considering possible sources of error it is shown conclusively that malarial treatment tends to prolong life, to improve the condition of those who must remain under care, and to increase very greatly the proportion of patients who can be discharged from certificate, and the probability that such discharge will be a success. The results during subsequent years confirm these findings. Altogether, the effect of treatment in 1597 cases is reported; as ascertained at the end of 1927, 541 died, 652 remained in hospital, and 404 were at liberty.

Attention is directed particularly to the mortality resulting from malaria. A relatively large number of deaths take place within two months of inoculation. According to the experience of the Wagner-Jauregg Clinic, this is avoidable, and efforts are being made at various mental hospitals in Great Britain to reduce the mortality. There is evidence also that the administration of antisyphilitic drugs in conjunction with malaria might lead to even better results. It is generally agreed that the best results from malarial therapy are obtained in early cases, but there is little or no provision for giving treatment until the patient becomes certifiable and can be sent to a mental hospital. An extension of facilities, either by alteration of the law relating to insanity or by the establishment of other treatment centres, will be necessary before the best results are obtained.

Rear-Admiral Meagher and the Board of Control are to be congratulated on the production of such an important account of malarial treatment. It demonstrates what can be done by utilising the facilities which the Board have for studying such problems, and it is to be hoped that these might be applied to the further investigation of a disease concerning the essential nature of which, as is quoted in the preface, we are quite in the dark.

[1] Board of Control (England and Wales). General Paralysis and its Treatment by Induced Malaria. By Surgeon Rear-Admiral E. T. Meagher. Pp. 88. (London: H.M. Stationery Office, 1929.) 2*s*. net.

Prehistoric Macedonia.

IN *Antiquity* for September, Mr. W. A. Heurtley, Director of the British School of Archæology in Athens, summarises the evidence bearing on the prehistory of Macedonia which has been acquired by the excavations carried out in recent years by the School, by Mr. S. Casson, and by the Archæological Service of the French Army in 1917–19. The sites examined are situated in the Vardar Valley, the neighbourhood of Salonika, the Valley of the Haliakmon, the Lankada Valley, and Chalcidice. An Early Iron Age cemetery at Patele was also excavated by Russian archæologists before the War, and a neolithic site at Olynthus by American excavators in 1928.

The neolithic culture resembles the Second Thessalian period, but as it seems to be earlier the movement would appear to be from north to south. At the beginning of the Bronze Age, Central Macedonia and Chalcidice were colonised by people coming from Asia Minor, evidently in search of gold. The trade relations were not with the Ægean, but with Troy, the Black Sea, and southern Russia. In the Middle Macedonian period, central Macedonia and Chalcidice diverge. In both the Anatolian culture was interrupted, central Macedonia falling under the influence of her northern neighbour, while Chalcidice was overrun by the Minyans, who were thought to have come from Troy, were possibly Indo-European, and may have introduced an Aryan speech into Chalcidice and Greece.

In central Macedonia, on the other hand, the pottery suggests Danubian pottery of an earlier date, or it may have developed locally from the incised style of the previous period. Some passed into Thessaly, the emigrant Macedonians creating the culture of the

Third Thessalian period, and living a nomad life which corresponds generally to the wanderings of the Dorians as recorded by Herodotus. In the late Macedonian period, relations between central Macedonia and Chalcidice were resumed. Either the older population had revived, or the fusion between the old and the new had become more complete.

Iron slag found at Vardaroftsa suggests that iron was worked before the coming of the Mycenæans, and may have been the object of their coming. At the end of the period the Vardar Valley was overrun by Danubians, probably from Hungary, forcing some Macedonians to follow their ancestors into Thessaly. In the Iron Age the former inhabitants and their descendants returned and revived their half-agricultural, half-mining mode of life. Relations with the Ægean were not revived until the arrival of Greek colonists in Chalcidice.

As regards general conclusions, the evidence points to acceptance in Macedonia of the chronological scheme which holds good for Crete, the Islands, and mainland Greece; thus the evolution of Macedonia is parallel with that of the Ægean, of which world it forms an integral part. The archæological results support the claim of the Macedonians to be Greeks.

Superhardening Hardened Steel by Magnetic Means.

THE increase in hardness which occurs with many work-hardened metals when they are subjected to a low-temperature annealing treatment is well known and is made use of in the arts. Mr. E. G. Herbert has now considered, in a paper read recently before the Iron and Steel Institute, the question as to whether it might not be possible to apply some stimulus other than such a heat-treatment to effect a similar result. In a magnetic material a possible means of achieving such an object is to subject the worked metal to repeated changes of magnetic polarity. When this is done, it is shown that the hardness is increased by the magnetic treatment to exactly the same extent as it is by annealing at the optimum temperature.

Such heat and magnetic treatments appear, therefore, to be strictly alternative processes, producing the same atomic rearrangement in the deformed material. Thus it was found that when the specimen which had been magnetically hardened was afterwards subjected to a low-temperature anneal, no further increase of hardness resulted, whilst a specimen, hardened by 'blueing', was not affected by magnetic means. As an indication of the order of the changes of hardness involved may be taken the case of a hardened steel which had originally a hardness number of 810. When severely cold-worked, the hardness was increased to 935, after which it was magnetically treated and was further hardened to 1060.

Mr. Herbert also proposes an explanation of the many small critical points which have been observed in the physical properties of iron, steel, and many other metals and alloys as their temperature is raised. These critical points are clearly independent of any allotropic changes, and a satisfactory explanation has not hitherto been offered. It is now suggested that an explanation, in part at any rate, may be found on the following lines.

The space lattice of the substance must possess one or more natural vibrational periodicities and be capable of resonating to certain 'notes'. When the frequency of the vibrations of the atoms themselves corresponds with this periodicity of the lattice or with one of its harmonics, the lattice is forced into a resonant vibration. The fact that the atomic vibrations are not monochromatic is not considered to do more than to introduce complications since the lattice may correspond to a number of wires tuned to different notes. It is shown that, as would be expected, some at any rate of the critical points are temperatures of high true specific heat. F. C. T.

A Russian Expedition to Seistan.

AN expedition was undertaken to Persia in 1925 by E. Czerniakovska for the purpose of studying the cultivated as well as the wild local plants. In course of her journey she travelled as far as Seistan, and she has now published a general outline of the climate, geographical arrangement, situation, and water supply of this district (*Izvestia* of the State Russian Geographical Society, **60**, 1928).

The Seistan district occupies the delta of the Guilmend River; being situated in the extreme south-eastern corner of Persia, it lies on the borders of Afghanistan and Baluchistan and is separated from Khorossan by the Lut desert. Owing to the fact that it possesses extensive plots of cultivated land, it is in a position to supply Khorossan with wheat, cotton, melted butter, down, etc.

The author divides the Seistan district into the following regions:

(1) Northern and western portions, including the Neysar depressions, bordering in the south on the lakes Khamun-i-Farrakh and Khamun-i-Severak and on the lowland connecting them. This is a swamp country, overgrown with *Phragmites* and *Typha*. Aquatic plants are represented by *Potamogeton* and *Vallisneria spiralis* L. The inhabitants consist of Sayades and Maldars—half-savage tribes, who hunt, fish, and breed cattle.

(2) Riparian clayey strip of land, occupying the northern and western borders of mainland. The meagre vegetation consists of *Aeluropus villosa* Frin, *Cynodon dactylon*, *Cressa cretica*, *Alisma* and *Tamarix* species. Patches of land absolutely deprived of vegetation and covered by a fragile saline crust are met with. The inhabitants—the Goudars—live by cattle-breeding and by capturing birds for the purpose of obtaining their feathers.

(3) The sandy region situated in the southern and the south-eastern portion of the country. The vegetation of the sandy dunes consists of *Anthrophytum*, undersized *Tamarix*, saline *Schanginia baccata*, *Alhagi*, *Prosopis stefaniana*, and *Eragrostis megastachya*. Nearer to the Guilmend River drifting sands, which sometimes bury entire villages, occur. The population consists of Baluchi, who occasionally grow wheat.

(4) The forest region of the delta of the Guilmend River. This is the most fertile part of the country and has an abundance of water; as such it is the centre of cotton cultivation. The forests consist of *Tamarix dioica* and other *Tamarix* species. All the cleared plots serve for the cultivation of cotton, millet, and wheat.

(5) The region of saline clayey soil, lying in the centre of the country. Here trade is brisk, and agriculture is flourishing, the principal cultivated plant being wheat.

The author gives a vivid account of the customs and various occupations of the population. A map of the botanico-geographical division of the country is appended.

University and Educational Intelligence.

Aberdeen.—Dr. Henry Cook, who graduated M.B., C.M., at the University of Aberdeen in 1883, and died at Bristol on Aug. 3, bequeathed "the entire residue of his estate to the Treasurer for the time being of Marischal College, University of Aberdeen, Scotland, for the use and benefit of the said College". It is estimated that after paying legacy and succession duties, costs and expenses, the gift to Marischal College cannot be less than £50,000.

Cambridge.—D. R. P. Murray, of Pembroke College, has been re-elected to the Benn W. Levy Research Studentship for one year as from July 1, 1929.

At the inauguration of the new session at the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3, the chairman of the governing body, the Rev. J. F. Marr, in reviewing the work of the past academic year, stated that the provision of grouped courses of instruction has been greatly appreciated by those engaged in technical branches of industry, and further, that insistence on a good knowledge of fundamental science as an antecedent to specialised or vocational training has led to the most satisfactory results. An extension of advanced and post-graduate work had also been made with considerable success. Valuable contributions to industrial research have been made by students of the Institute trained in methods of research. The programme of work for the present session includes a considerable extension of the course of lectures on coal carbonisation and the addition of two courses of lectures, on the application of X-ray analysis to chemical problems and micro-chemical analysis respectively.

The League of Nations Intellectual Co-operation Committee presented at the League's recent assembly a report on its work and that of the League's chief executive organs in this field, the International Institute of Intellectual Co-operation, which has its seat in Paris, and the International Educational Cinematographic Institute at Rome. As for the last-named Institute, which was inaugurated on Nov. 5, 1928, a mere outline of its scope is given with an announcement that a circumstantial report on its work will be submitted to the next meeting of the governing body in October. Meanwhile, the Institute is congratulated on the publication of the *International Review of Educational Cinematography*. Educational work figures largely in the account of the other Institute's activities, including the expansion of the Educational Information Centres at Geneva and Paris, the publication of a handbook on "The Aims and Organisation of the League of Nations" for the use, primarily, of teachers, and the publication of a periodical, *Educational Survey*, destined to appear twice a year. Other activities mentioned are the promotion of periodical meetings designed to improve university relations, for example, meetings of representatives of university information offices, of institutes for the scientific study of international relations, and of directors of higher education in various countries, the development of international co-ordination of libraries and of the bibliography of the various sciences, the development of the work of the International Museums Office, both in the field of museography and in that of the co-ordination of museums, and the publication of the review *La Co-opération intellectuelle*.

Calendar of Patent Records.

October 26, 1724.—A patent was granted to John Brent on Oct. 26, 1724, for "a wind engine or machine which would be useful in occasioning motion to all sorts of mill-work and for divers other uses and purposes, far exceeding all wind engines hitherto practised, whose fanes move horizontally and are so disposed as to work with the wind blowing from any point of the compass without turning or altering the position of the engine, the like of which had never been used or exercised in any of our dominions". This appears to be the first patent for a windmill with horizontal vanes.

October 30, 1786.—The power loom was patented by the Rev. Edmund Cartwright on Oct. 30, 1786, and a factory was established at Doncaster the following year with ten looms, worked at first by animal power but later by a steam-engine. This was Cartwright's second loom patent, but the first one, dated the previous year, had been for a crude machine which he had invented, as he himself says, before he had turned his thoughts to anything mechanical either in theory or practice, or had ever seen a loom at work, or knew anything of its construction. The Doncaster factory was not a success commercially, and closed down in 1793.

October 30, 1811.—The steam printing-press was the invention of Friedrich König, who had come to England from Germany in 1806. His cylinder machine—which was used for the first time for newspaper printing by the *Times* in 1814, and delivered on that occasion 1100 sheets an hour—was patented on Oct. 30, 1811.

October 31, 1778.—The first real improvement in the modern door-lock was patented by Robert Barron on Oct. 31, 1778. Previously, security had been obtained only by fixed wards and by tumblers which had simply to be lifted clear of the bolt, but in Barron's lock the levers or tumblers had to be lifted a definite distance by the bits of the key, and blocked the bolt in every other position, whether this was too low or too high. The arrangement of the modern lever lock is the same.

October 31, 1797.—Joseph Bramah's patent, dated Oct. 31, 1797, for a method of raising beer from cellars, includes a process for making jointless lead tubing in which lead in its liquid state is pumped or forced through an annular mould. The mould is kept hot at one end and cooled at the other, so that the lead, entering liquid, issues in the solid state in the form of a tube of the size and shape required.

November 1, 1825.—The first road-cleaning machine with a rotary brush was patented by William Ranyard, of Kingston, on Nov. 1, 1825. The brush was worked by gearing from the road wheels and collected the dust and refuse into a bin carried on the cart.

November 2, 1785.—Lionel Lukin, coachbuilder of Long Acre, has the first patent for a lifeboat, this being granted on Nov. 2, 1785, for a method of "constructing boats for either sailing or rowing which will neither overset in violent gales nor sudden gusts of wind, nor sink if they should by any accident be filled with water". Lukin converted a Norway yawl by placing air boxes at the stem and stern, watertight compartments along the inside of the gunwales, and outside a belt of solid cork, whilst stability was increased by the provision of an iron keel, and a boat of this construction was used with some success. William Wouldhave followed with a self-righting boat in 1789, but Henry Greathead's *Original*, launched in 1790, was the first lifeboat to be placed in regular service. The Royal National Lifeboat Institution celebrated its centenary in 1924.

Societies and Academies.

LONDON.

Optical Society, Oct. 10.—**T. H. Court** and **Moritz von Rohr**: Development of the telescope (1675–1830). J. Lipperhey was the first to construct a practical telescope for military use in 1608. Galileo developed this type for astronomical purposes. The Capuchin Father v. Schyrle in 1645 printed, in the form of a cryptogram, rules for making an erecting eyepiece made of three collective lenses. Starting from this point the authors trace the development of the telescope in England down to 1830. The invention of the achromatic objective is attributed to Chester Moor Hall in 1733. He kept his invention secret, but it leaked out, and was patented by John Dollond, whose elder son, Peter, brought successful actions for infringement against London opticians. New light is thrown on this celebrated invention and on many others by a careful examination of the instruments and documents in the well-known Court Collection.

ROME.

Royal National Academy of the Lincei, June 16.—**E. Almansi**: The motion of a body of variable mass.—**Q. Majorana**: Absorption of ultra-violet or infra-red rays by cloud. In connexion with the author's two systems of optical telephony by means of ultra-violet or infra-red rays, laboratory tube experiments fail to reveal any sensible absorption of the radiant energy when the tube is filled with either dry or wet air, provided that this is perfectly clear. Under certain cloudy conditions it appears that infra-red rays may be transmitted twice as far as ultra-violet rays.—**S. Franchi**: A new facies of Upper Trias in the Italian Maritime Alps.—**G. Levi**: Supposed specific cytological characters of the cytoplasm of the sexual cells. No constant specific differences exist, in the vertebrates, between the chondriome of the gonocytes and ovocytes on one hand and that of the somatic cells on the other.—**M. Picone**: The isolated singularity of harmonic functions.—**A. de Mira Fernandes**: Christoffel's quadruple tensor and Riemann's tensor.—**F. Sbrana**: Geodetic curvature and parallelism on a surface.—**G. Mazzone-Sangiorgi**: The prime elements of a new general theory for the motion of waters and other fluids (1).—**E. Gugino**: Theorem of the maximum kineto-dynamic effect in relation to the principle of Hertz's directism.—**P. Emanuelli**: The galactic pole and the circumpolar galactic region.—**A. Carrelli**: The longitudinal distribution of photo-electrons.—**A. Tulli**: Further contribution to the study of the mummification of the ancient Egyptians: chemical analysis of a mummy from the Vatican Museum. Analysis of the tissues near one of the vertebræ of the neck of this mummy demonstrated the absence of natron, heavy metals, and arsenic. Treatment with light petroleum, alcohol, and water successively gives 6·2, 12·0, and 23·6 per cent of matters soluble in these solvents. The use of gum-resins is indicated.—**P. Saccardi**: Melanins from adrenaline. When a faintly alkaline solution of the melanin-like substance, obtained by the oxidation of adrenaline with chlorine water, is administered subcutaneously to the rabbit, it causes decided melanuria, characteristic melanoderma and trichoderma, and browning of the subcutaneous connective tissue at the injection area. These results furnish evidence of the analogy in constitution between pyrroles, natural melanins, and adrenaline black, and indicate that, in definite physiological and pathological conditions, adrenaline may give rise to melanins.—**D. Bigiavi**: Reactions of the diazohydrates. The Angeli-Cambi formula for the diazohydrates furnishes an explanation of the transformation of iso- into normal diazohydrate, which resembles the Beckmann conversion, since it consists in the migration of the oxygen atom from nitrogen to nitrogen; in the former change, when induced by hydrochloric acid, the intermediate formation of diazonium chloride is probable. The fact that the sodium salt of an isodiazohydrate does not react with β-naphthol, arsenite, etc., whereas the free isodiazohydrate immediately reacts, has an analogy in the different behaviour of sodium nitrite and nitrous acid towards phenols, etc., and that of benzaldoxime and its sodium salt towards potassium cyanide.—**M. Lecat**: Azeotropy in binary systems containing a hydroxylated compound.—**G. Bini**: Certain characteristics of the Red Sea with regard to the nitrogen cycle. The waters of the Red Sea contain relatively high proportions of ammonia, owing partly to the paucity of vegetation, especially of the fixed variety, and partly to putrefaction of the abundant marine animals, this being favoured by the marked alkalinity and by the high temperatures of the water and air. Large amounts of nitrites are present in certain regions, these being derived from animal putrefaction and from the action of denitrifying bacteria on nitrates. The latter were not found in any of the water samples analysed and are doubtless absorbed by the dentrifying bacteria; to this action is due, in large part, the scarcity of vegetation.—**A. Ferrari** and **F. Giorgi**: The crystalline structure of bromides of bivalent metals. The following bromides have crystalline structures of the cadmium iodide type, their characteristics being: $CoBr_2$, $a = 3{\cdot}685 \pm 0{\cdot}005$ A., $c = 6{\cdot}120$ A., $c : a = 1{\cdot}66$, density $= 5{\cdot}072$; $FeBr_2$, $a = 3{\cdot}740 \pm 0{\cdot}005$ A., $c = 6{\cdot}171$ A., $c : a = 1{\cdot}65$, density $= 4{\cdot}790$; $MgBr_2$, $a = 3{\cdot}815 \pm 0{\cdot}005$ A., $c = 6{\cdot}256$ A., $c : a = 1{\cdot}64$, density $= 3{\cdot}876$; $MnBr_2$, $a = 3{\cdot}820 \pm 0{\cdot}01$ A., $c = 6{\cdot}188$ A., $c : a = 1{\cdot}62$, density $= 4{\cdot}549$. Cadmium bromide, however, exhibits a rhombohedric cell of the magnesium chloride type, with the dimensions, $a = 7{\cdot}72 \pm 0{\cdot}01$ A., $\alpha = 61° 40'$; this cell contains four molecules and the calculated density is 5·36, the observed value being 5·192.—**M. Fenoglio**: Petrographical studies on the Canavese zone: Belmonte granite.—**A. Bianchi**: Petrographical notes on the region of the Aurine Alps and of the Vedrette Giganti (Upper Adige) (1).—**L. Bucciante**: Duration of survival of the different tissues of hens' embryos with which incubation has been interrupted.—**L. Bucciante** and **E. De Lorenzi**: Correlation of the number and magnitude of single types of retinic neurones in animals of different body size.—**G. Lentati**: Investigations on the histogenesis of the islets of Langerhans in *Ovis aries L.*—**G. D'Anneo**: A plurisegmental central preparation of *Bufo vulgaris*.—**A. Galamini**: Further investigations on the food value of the potato for albino rats. While a daily ration of 50 gm. of boiled potato and 4 gm. of butter keeps albino rats alive, it is insufficient for normal growth in a growing rat. The addition, after 120 days, of 1-2·5 gm. of fibrin caused normal increase in weight. Alcohol or Osborne's salt mixture also improves the food value of the diet, the adult rat then increasing in weight; if these additions are discontinued, the gain in weight is lost.—**S. Ranzi**: Embryonic growth of the cephalopods.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 8, Aug. 15).—**E. B. Babcock** and **J. L. Collins**: Does natural ionising radiation control rate of muta-

tion? (see NATURE, Aug, 10, 1929, p. 227).—**R. J. Anderson**: Chemical investigation of biologically active lipoids of tubercle bacilli. Lipoid fractions from tubercle bacilli all give rise to tubercular tissue, due apparently to the presence of certain new liquid saturated fatty acids. The most active acid is dextrorotatory and has been named phthioic acid; its formula is $C_{26}H_{52}O_2$, and it is thus an isomer of cerotic acid.—**Th. Dobzhansky**: A homozygous translocation in *Drosophila melanogaster*. Certain of the progeny of flies treated with X-rays, though normal in appearance, show linkage of genes of the third group with those of the fourth.—**Francis Bitter**: Magnetic susceptibility of nitric oxide at 296° K. and 216° K. Four parallel pyrex cylinders were suspended in a cluster by a quartz fibre; two opposite tubes were filled with air (paramagnetic) and the other two and the surrounding space with nitric oxide. The displacement of the system in an inhomogeneous magnetic field was measured.—**R. C. Gibbs, H. E. White, and J. E. Ruedy**: Hyper-fine structure in spectral lines—especially those of singly ionised praseodymium.—**Alexander Goetz and Maurice F. Hasler**: A method of producing long single-crystals of metal and a study of the factors influencing crystal orientation and perfection. Molten metal (bismuth) was sucked into a carefully cleaned glass tube 15-20 cm. in length, through the fine-pointed end from which crystallisation started. The tube and metal crystal are then reheated above the melting-point of the metal, and sufficiently to soften the glass, and the whole drawn out to the required length and diameter, the conditions of cooling being maintained as constant as possible. The orientation of the crystal axes seems to be such that the strains imposed by crystallisation are a minimum.—**J. C. Boyce and K. T. Compton**: Higher spark spectra of neon and argon in the extreme ultra-violet. An electrodeless ring discharge was used.—**Gerald L. Pearson**: Relative probabilities of the ionisation of K and L electrons of equal ionisation energy.—**J. B. Scarborough**: The invalidity of a commonly used method for computing a certain probable error.—**Miguel A. Basoco**: On certain Fourier series expansions of doubly periodic functions of the third kind.—**G. A. Miller**: Automorphism commutators.—**John D. Elder**: Arithmetised trigonometrical expansions of doubly periodic functions of the third kind.—**Worth H. Rodebush**: The entropy of hydrogen. The data previously obtained at low temperatures must have referred to a non-equilibrium mixture of the two molecular species now recognised.—**P. W. Bridgman and J. B. Conant**: Irreversible transformations of organic compounds under high pressures (Preliminary paper). Pressures up to 12,000 atmospheres were used for periods up to 56 hours. Certain substances were partially polymerised; isoprene and dimethyl butadiene became jelly-like solids which, on standing in air, shrunk by evaporation of the liquid hydrocarbon, leaving a rubber-like solid. Carboxy-hæmoglobin under pressure gives a precipitate resembling the 'denatured' substance obtained by the action of alcohol.—**Elery R. Becker and Ralph C. Everett**: Progress report on weight increases in lambs with and without rumen Infusoria. Lambs freed from rumen Infusoria showed considerably bigger increases of weight.—**Elery R. Becker and T. S. Hsiung**: The method by which ruminants acquire their fauna of Infusoria, and remarks concerning experiments on the host-specificity of these protozoa. Infection is spread by mouth contamination. Infusoria from the stomach of goat, cow, or sheep show no host-specificity within these hosts, but those from colon or fæces of horse will not develop in the rumen of goats.

Official Publications Received.

BRITISH.

Journal of the Royal Microscopical Society. Series 3, Vol. 49, Part 3, September. Pp. xvi+211-318. (London.) 10*s.* net.

Report for 1928 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. No. 37. Edited by Prof. James Johnstone and R. J. Daniel. Pp. 182+4 plates. (Liverpool.)

The Year's Photography, 1929-1930. Pp. 25+xlix+90 plates. (London: Royal Photographic Society.) 2*s.* 6*d.*

Hull Museum Publications. No. 158: The Evolution of the Miners' Safety Lamp, and Record of Additions. Edited by T. Sheppard. Pp. 24. No. 159: Archery Medals and Memoranda. By T. Sheppard. Pp. 16. No. 160: Illustrated Guide to the Facsimile of the Bayeux Tapestry. Edited by T. Sheppard. Pp. 19. (Hull.)

Dominion Museum. Bulletin No. 13: The Whare Kohanga (The 'Nest House') and its Lore; comprising Data pertaining to Procreation, Baptism and Infant Betrothal, etc.; contributed by Members of the Ngati-Kahungunu Tribe of the North Island of New Zealand. By Elsdon Best. Pp. 72. (Wellington, N.Z.: W. A. G. Skinner.) 4*s.*; paper, 2*s.* 6*d.*

Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3. Prospectus of Day and Evening Classes for Men and Women, Session 1929-30. Pp. 68. Chelsea College of Physical Education. Prospectus, Session 1929-30. Pp. 10. Chelsea School of Art. Prospectus, Session 1929-30. Pp. 8. Chelsea School of Cookery, Housecraft and Dressmaking. Prospectus, Session 1929-30. Pp. 8. Chelsea School of Pharmacy. Prospectus, Session 1929-30. Pp. 18. Chelsea School of Chiropody. Prospectus of Day and Evening Classes, Session 1929-30. Pp. 8. (London.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 54, Part 2, September. Pp. iv+253-460+lxxxv-cxliv+xxii+49 plates. (London.) 7*s.* 6*d.*

Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20th September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office.) 2*s.* net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1224 (Ae. 379): On the Flow of Air adjacent to the Surface of an Aerofoil. By Dr. N. A. V. Piercey and Dr. E. G. Richardson. (T. 2694.) Pp. 23+15 plates. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 2: The Glacial Retreat in Iar Connacht. By Prof. J. Kaye Charlesworth. Pp. 95-106+1 plate. (Dublin; Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

FOREIGN.

U.S. Department of Agriculture. Farmers' Bulletin No. 1582: Protection of Log Cabins, Rustic Work and Unseasoned Wood from Injurious Insects. By R. A. St. George. Pp. ii+20. 5 cents. Farmers' Bulletin No. 1601: Collection and Preservation of Insects for Use in the Study of Agriculture. By Margaret C. Mansuy. Pp. ii+20. 5 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 147: Archeological and Historical Investigations in Samaná, Dominican Republic. By Herbert W. Krieger. Pp. iv+91+27 plates. (Washington, D.C.: Government Printing Office.) 40 cents.

Department of Commerce: Bureau of Standards. Research Paper No. 81: Note on a Mercury Spark Gap for Instantaneous Photography. By L. F. Curtiss. Pp. 53-55. 5 cents. Research Paper No. 89: The First Spectrum of Krypton. By William F. Meggers, T. L. de Bruin and C. J. Humphreys. Pp. 129-162+4 plates. 15 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 89: The Natural Crossing of Cotton Flowers in Egypt; its Distribution in Time and Space, and its Cause. By Dr. W. Lawrence Balls, assisted by Dr. J. Templeton, C. H. Brown, M. Kilani and others. Pp. 27. (Cairo: Government Press.) 5 P.T.

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 478: An Economic Study of Farm Buildings in New York. By I. F. Hall. Pp. 87. Bulletin 481: The Clover-Flower Midge (*Dasyneura leguminicola* Lintner) By Lawrence Paul Wehrle. Pp. 35. Bulletin 485: Farm-Property Taxation in New York. By Irving J. Call. Pp. 49. Bulletin 488: A Study of some Factors affecting Seed-Stalk Development in Cabbage. By Julian C. Miller. Pp. 46. (Ithaca, N.Y.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1928. Pp. 25. (Weltevreden: Landsdrukkerij.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 1: Absorption Lines of the Infra-red Solar Spectrum. By C. G. Abbot and H. B Freeman. (Publication 3026.) Pp. 17+5 plates. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 68, No. 2. Pp. 69-161. (Philadelphia.)

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 18, Article 1: The Native and Naturalized Trees of Illinois. By Robert Barclay Miller and L. R. Tehon. Pp. 339 (98 plates). (Urbana, Ill.)

CATALOGUES.

Fine Filtration and Ultra Filtration. Pp. 32. Catalogue of Scientific Text Books. Pp. 19. (London: A. Gallenkamp and Co., Ltd.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 11.) Pp. 199-274. (Paris: Libr. Adrien-Maisonneuve.)

The Librarians' Catalogue of Periodicals, Journals and Transactions of the Learned Societies, Library Editions and Standard Books in all Departments of Literature, English and Foreign, including Books for the Collector and Student. (Catalogue 334.) Pp. 98. (Cambridge: W. Heffer and Sons, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 25.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Prof. R. Stenhouse Williams and Members of the Staff of the National Institute for Research in Dairying, Shinfield, Reading: The Scope of the Work of a Research Institute in Dairying.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—F. C. Connelly: Some Additional Lines in the Secondary Spectrum of Hydrogen.—Dr. E. G. Richardson and E. Tyler: The Transverse Velocity Gradient near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established.—B. K. Johnson: Resolving-power Tests on Microscope Objectives used with Ultra-violet Radiation.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Dislocations of the Hip-joint—Congenital and Acquired.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Col. E. Briggs: The Chemist in Industry (Chairman's Address).

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. W. H. Hatfield: The Fabrication of Acid-resisting Steel Plant (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Newcastle-upon-Tyne), at 6.30.—L. E. Smith: Presidential Address.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—R. P. Wagner: Some New Developments in the Stephenson Locomotive Boiler.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—P. C. Dewhurst and others: The Requirements of Overseas Locomotive Engineers in Respect of Locomotive Design and Details.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—The Work of the British Electrical Development Association.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. Bruff: Electric Welding as applied to Bridges and other Structures on the L. and N.E. Railway.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. S. P. James: Modern Aspects of the Epidemiology, Prevention, and Treatment of Malaria.

SATURDAY, OCTOBER 26.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—R. S. Anderson: Presidential Inaugural Address.—Dr. W. Hopkins: The Distribution and Sequence of the Non-Marine Lamellibranchs in the Coal-Measures of Northumberland and Durham.—Discussion on Paper by R. G. Carruthers on Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne.

MONDAY, OCTOBER 28.

INSTITUTE OF ACTUARIES, at 5.—H. Freeman: Notes on a Short Method of Valuation of Pension Funds.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens of Calculi.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Discussion on Systematic Research by Industrial Undertakings.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. A. Robinson: Chairman's Address.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—J. McK. Ackland: Oral Sepsis in its Relation to General Disease (Presidential Address).—F. N. Doubleday: Two Cases of Hypertrophy of the Jaw.

MEDICAL SOCIETY OF LONDON, at 8.30.—A. E. H. Pinch, Prof. S. Russ, and others: Discussion on Radium Therapy.

TUESDAY, OCTOBER 29.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—T. Roles: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. Guild: Colour and its Measurement (Traill Taylor Memorial Lecture).

SOCIETY OF DYERS AND COLOURISTS (Huddersfield Section) (at Huddersfield).—M. le Blin Desbleds: Colour Measurement.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at College of Science and Technology, Leicester).—Hon. Sir Charles A. Parsons and J. Rosen: Direct Generation of Alternating Current at High Voltages.

WEDNESDAY, OCTOBER 30.

INSTITUTION OF MINING ENGINEERS (at Geological Society), at 11 A.M.—Annual General Meeting.—At 2.15.—Discussion on Paper by R. Clive: The Underground Conveying and Loading of Coal by Mechanical Means.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Derby Technical College), at 7.30.—D. L. Pellatt: The Manufacture of Viscose Rayon.

INSTITUTION OF THE RUBBER INDUSTRY (Birmingham Section) (at Grand Hotel, Birmingham).

THURSDAY, OCTOBER 31.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—H. C. Dent: The Use of Books in the School and Home.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Prof. W. Morgan: The Member and the Institution.

COKE OVEN MANAGERS' ASSOCIATION (at Hotel Great Central).—Annual Meeting.

FRIDAY, NOVEMBER 1.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Cyclonic Disturbances of Sea Level. Chairman, Sir Richard Gregory. Speakers, Dr. Doodson and Prof. Proudman.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Spinal Deformities in the Sacroiliac Region.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Burn: The Development and Performance of the Richardsons-Westgarth Oil Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7.—E. W. Hill: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Alfred Herbert, Ltd.: Technical Film: The Age of Speed.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Words and Names.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. J. Blomfield, Sir Francis Shipway, and others: Discussion on Avestin Anæsthesia.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—J. W. Berry: Cold Working of Metals.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society) (at Manchester).—Dr. F. A. Freeth: Industrial Research.

SATURDAY, NOVEMBER 2.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—A. H. Allcroft: The Significance of Circular Churchyards.

PUBLIC LECTURES.

FRIDAY, OCTOBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinate Biochemistry of the Cell and Tissues: The Ministers of Metabolic Change (Harben Lectures) (2)

UNIVERSITY COLLEGE, at 5.30.—C. S. Elton: The Future of Animal Ecology. (Succeeding Lectures on Nov. 1 and 8.)

SATURDAY, OCTOBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Faces and Finger Prints.

MONDAY, OCTOBER 28.

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. F. Baker: Physics and Geometry.

TUESDAY, OCTOBER 29.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Tissues in Youth and Age (Chadwick Lecture).

KING'S COLLEGE, at 5.30.—Prof. J. S. Mackenzie: The Conception of a Cosmos.

WEDNESDAY, OCTOBER 30.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. F. Hurst: The Asthma Problem.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—Dr. Alice Werner: Kingdom of Congo.

KING'S COLLEGE, at 5.30.—Prof. E. V. Appleton: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: The Physical Sciences.—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality—The World of Ideal Experience.

FRIDAY, NOVEMBER 1.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Tissue Anarchy (Harben Lectures) (III.).

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Nervous System in Relation to Health (Chadwick Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Prof. G. Elliot Smith: The Evolution of Man.

SATURDAY, NOVEMBER 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Sculpture in Relief.

CONFERENCES.

OCTOBER 25.

INSTITUTE OF FUEL (at Institution of Mechanical Engineers).

Friday, Oct. 25, at 10.15 A.M.—J. S. Atkinson: The Installation and Operation of Gas Producer Plants for Industrial Furnaces.—E. C. Evans: The Economics of Coke-oven Gas Utilisation in Industry.

At 2.30.—E. H. Lewis: Heat Insulation.—A. J. Dale and A. T. Green: (*a*) Fuel Control in the Ceramic Industry; (*b*) Refractories in Application to the Fuel Industries.

OCTOBER 30 TO NOVEMBER 2.

NATIONAL COUNCIL FOR MENTAL HYGIENE (at Central Hall, Westminster).—Subjects to be discussed include Sex Education, the Personal Equation in Industry, the Child and the Parent, and Delinquency, and there will be group discussions on the Working of the Juvenile Courts, the Relation of the Work of Public Health Nurses and Social Workers to the Mental Health of the Community, and the Problem Child at Home and in School.

NATURE

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Ships of the Atlantic Ferry.

IN the story of man's struggle with the forces of Nature, there are few more fascinating chapters than that relating to the conquest of the Atlantic by steam. To cross the western ocean is an every-day affair, and except that no ship can be built that will not roll and pitch amidst the great waves of an ocean swept by gales for more than half the year, travellers are carried in comfort and luxury and with regularity and dispatch undreamt of a century ago. The first ever to carry passengers by steamboat, to form a steamboat company, and to advertise his project, was John Fitch, whose experiments were made on the Delaware and who died in 1798. There were many other pioneers, but of them all, Fitch alone envisaged the future of steam on the western ocean, and with prophetic vision wrote of steam navigation that "The Grand and Principle Object must be on the Atlantick, which would soon overspread the wild forests of America with people, and make us the most oppulent Empire on Earth".

Forty years separate Fitch's untimely death and the first voyage of the famous *Great Western*—Brunel's fine ship which definitely established trans-Atlantic steam navigation. Other ships had crossed the ocean before 1838, partly by steam, partly by sail, but the real pioneer ship of the Atlantic ferry was the *Great Western*, the performances of which, from the day she left Bristol on her maiden voyage until she came to the Thames to be broken up, reflected nothing but credit on her designers and constructors. Followed soon by the *Royal William*, the *Liverpool*, the *British Queen*, by Cunard's ships, the *Britannia*, *Acadia*, and *Caledonia*, and by the ill-fated *President*, before the close of 1840, the Atlantic had been crossed and recrossed by steam vessels more than forty times, and ever since, the Atlantic has been the testing ground and the racecourse of the finest ships in the world. Wooden ships have given way to iron ships and steel ships, paddle ships to screw ships; simple expansion engines were replaced by compound engines, and these again have been superseded by triple expansion engines and Parsons' steam turbines; the displacement of ships has risen from 1000 tons to nearly 60,000 tons, passenger lists runs into thousands, and the time of passage has been reduced from the sixteen days of the *Great Western* to the four days of the *Bremen*; and with greater size and greater speed has come vastly increased safety.

During the first years of the Atlantic ferry,

progress was almost entirely due to men trained in the hard school of practical experience, and the designers who possessed more than a passing acquaintance with the scientific principles underlying the work of the naval architect could be counted upon the fingers of one's hands. With the foundation of the Institution of Naval Architects in 1860, the opening of the Royal School of Naval Architecture at South Kensington four years later, and with the work of Woolley, Merrifield, Rankine, Scott Russell, Barnaby, and especially William Froude, the study of the theory of naval architecture became a recognised part of the training of every constructor, and this with immensely important results to our shipbuilding industry.

This aspect of the subject is recalled by the paper on "Atlantic Ships" read to the Institution of Engineers and Shipbuilders in Scotland by Sir John Biles on Oct. 8. A Portsmouth Dockyard apprentice, Sir John Biles was one of the last students of the old school at South Kensington, from which he passed to Greenwich; in 1876 he was employed on the construction of the notable little vessels H.M. ships *Iris* and *Mercury*, and then in 1880, leaving the Admiralty, he joined the firm of J. and G. Thomson of Clydebank and became concerned with the designing of ships for the Atlantic. Beginning with the *Aurania* and the *Pavonia*, he designed the *America*, the *City of Paris*, and *City of New York*, all remarkable ships in their day, and there is probably no one alive to-day with a more intimate knowledge of the history of subsequent developments or indeed of shipbuilding in all its branches. Given a free choice, it was therefore but natural for Sir John Biles to take for his subject "Atlantic Ships", and his paper is not only a valuable historical review of the achievements of the last half-century but also an interesting introduction to the problem of the Atlantic ship of to-day. His own ships, the *City of Paris* and *City of New York*, were soon surpassed by the *Campania* and *Lucania*, and these again by the German vessels the *Kaiser Wilhelm der Gross* (1897), *Deutschland* (1900), *Kronzprinz Wilhelm* (1901), and *Kaiser Wilhelm II.* (1903). With these vessels speeds had increased to $22\frac{1}{2}$ knots and the time of crossing had been reduced to $5\frac{1}{2}$ days. Our reply, as everyone knows, was the construction of the *Mauretania* and *Lusitania*, which began running in 1907. The sinking of the *Lusitania* in 1915 then left the *Mauretania* without a rival, and until the coming this year of the new German ship *Bremen*, she has retained the blue ribbon of the Atlantic.

Though Sir John Biles begins his paper by remarking that the way to regain the blue ribbon will no doubt be found by the wise young men of the period, he says the problem seems to be much the same as when the *Mauretania* was projected. "Examination of the best information available shows that a ship 1000 feet long by 110 feet beam, if built for Atlantic conditions with geared turbines and water-tube boilers of 500 lb. pressure, would realise a speed of probably 33 knots when fully loaded." But whether such a ship would pay, only the owners could possibly determine. The type of machinery for such a vessel was dealt with by General E. de Vito in a paper at the recent meeting of the Institution of Naval Architects at Rome, but the relative merits of the geared steam turbine, the turbo-electric drive, and the Diesel electric drive for very high speed ships has yet to be determined. It is evident, however, that Sir John Biles does not think that we shall regain the record with a Diesel electric ship.

The Lancashire Witches.

The Trial of the Lancaster Witches, A.D. MDCXII. Edited with an Introduction by G. B. Harrison. Pp. xlvii + 188. (London: Peter Davies, 1929.) 10*s.* 6*d.* net.

IN "The Wonderful Discoverie of Witches in the Countie of Lancaster" we have one of the most authentic documents in the whole literature of witchcraft. It was written as an account of the trial of a number of witches arraigned at an assize held at Lancaster in 1612 by the Clerk to the Court, Thomas Potts, at the request of the two judges before whom the case was tried, and was revised by one of them. It is, therefore, of the highest authority. The book was completed and entered on the Stationers' Register before the end of the same year, and is dated 1613. Not unnaturally it is of great rarity, while the reprint by the Chetham Society, edited by James Crossley in 1845, is not often available. Mr. Harrison's reprint, which follows the original exactly, is therefore cordially to be welcomed in view of the recently revived interest in the subject of witchcraft.

The story of the trial was made familiar to the reading public by Harrison Ainsworth's novel "The Lancashire Witches"—as a work of fiction perhaps now almost forgotten. The protagonists were two old women of eighty living in the Pendle Forest. One of them, Mother Demdike, had made witches of all her family, her daughter and grandchildren, by name Device. Her rival, Mother

Chattox, had only a daughter who was also a witch. Mother Demdike had been active in witchcraft at least so long before as 1591. She had been joined some five years later by Mother Chattox; but the two families had quarrelled. A number of other witches of both sexes, but mostly women, were associated with them. Twenty, two only being men, were said to have attended the Good Friday feast at Malking Tower in the year 1612 when a plot was hatched to blow up Lancaster gaol, kill the keeper, and liberate Mother Demdike and the other witches then awaiting trial.

With one exception, these witches belonged to the lower stratum of society. The exception was Mistress Alice Nutter, a woman of property and position. Why she should have joined the witches is difficult to see. Perhaps the reason is to be sought in a suggested relationship with that branch of the Nutter family of which three members were said to have lost their lives by witchcraft. In addition to the usual crimes of harming cattle and livestock, the witches were accused of causing at least sixteen deaths, mostly by the familiar method of slowly destroying a clay image of the victim. A local magistrate, Master Robert Nowell, stirred to activity by the state of terror into which the neighbourhood was thrown, had Mother Demdike, Elizabeth Device, her daughter, Mother Chattox and her daughter, Anne Redfearn, brought before him, and after examination and depositions taken, committed them for trial to Lancaster gaol. This was early in 1612. On Good Friday the meeting in Pendle Forest at Malking Tower took place, and as a consequence further arrests were made.

Eleven prisoners—Mother Demdike had by now died in prison—were presented for trial at the August assizes before Sir James Altham and Sir Edward Bromley, justices of assize. These two judges at York in the preceding July had already condemned Jennet Preston, who had been present at the Malking Tower meeting. There were also awaiting trial at Lancaster four witches from Salmesbury, who were accused in particular of bewitching Grace Sowerbutts, a girl of fourteen, on her own evidence.

The trial of the Pendle witches was made the occasion of an expression of the enmity of the Chattox and Demdike families. Accusations and counter-accusations flew from side to side. The principal witnesses were James Device, himself accused, and his sister Jennet, a girl of nine years of age, daughter of Elizabeth Device and granddaughter of Mother Demdike. In passing it may be remarked how with some frequency in witch trials the principal witness is a child of tender years, son or daughter of the accused. Two points of moment in Jennet's evidence were the testimony as to the familiars attending the witches whom she claimed to have seen and the Good Friday feast at Malking Tower. Her brother also stressed these points. The importance of the evidence relating to this feast now lies in the fact that it has been considered by some to have been a ceremonial witches' banquet of the type characteristic of the cult. If this be so, it is the first mention of such a ceremonial in English witchcraft.

In the result, the accused were convicted and hanged with one exception. The fate of the Salmesbury witches differed. They were acquitted. The witness in chief, Grace Sowerbutts, broke down when the trial was practically completed, and in response to a question from the judge, put at the despairing request of the prisoners, confessed to imposture. She admitted that she had been instructed in her evidence by a Roman Catholic priest, who turned out to be a grandson of one and nephew of another of the prisoners.

The confession of Grace Sowerbutts throws a lurid light on the conditions of the times and locality. Panic reigned throughout the district—an atmosphere most tellingly re-created by Harrison Ainsworth in his novel. Lancashire was a hotbed of Roman Catholicism. Feeling was inflamed in both religious parties by recent events. The Gunpowder Plot was fresh in every mind. The action of the priest was said to have been dictated by the fact that the accused had recently left the Roman for the English Church. It is significant that, apart from a form of possession of Grace Sowerbutts and the killing of a small child, the heads of the indictment against the four Salmesbury witches were that they had eaten the flesh of the child, which they had exhumed, and from its fat had made an ointment for the purpose of changing their form, and that with others they had attended an assembly at which dancing and sexual indulgence had taken place with certain strange beings. It is worth while recalling that such accusations as these were the commonplaces of the trials on the Continent under the Papal Bulls against witchcraft and heresy.

Potts is almost violent in his comments on the imposture in the Salmesbury trial, notwithstanding his instructions to confine himself throughout to the facts of the cases, while he accepts the statements in the Pendle trial with equanimity and

approbation. His first editor, Crossley, suggests, but without any grounds whatsoever, that Jennet Device had also received instruction in her evidence. It is certainly curious that she should have dwelt so persistently on the feast at Malking Tower. Her brother James, though himself accused, was responsible almost equally with her for the result of the trial. He consistently emphasised the fact that the guests at the banquet "went out of the house in their own shapes and likenesses", and when they had "gotten on horseback, like unto foales, some of one colour some of another . . . they all presently vanished out of this Examinates sight". It was also James who, according to his own account, was instructed to attend Communion and "not to eate the bread the Minister gave him, but to bring it and deliver it to such a thing as should meet him on his way homewards". For refraining "the said thing threatened to pull him to pieces".

Is this the result of instruction, or was there something real but half understood and imperfectly described which underlay the statements of the two witnesses? Was there in this instance a real witch cult such as was alleged in Scotland and on the Continent, but for which there is little evidence in England? If it were not for the Salmesbury case, opinion might well incline to the latter view. Mr. Harrison, to whom we are indebted for this scholarly edition of Potts's work, holds that "on its face value the Lancaster trial reveals the practice of the witch cult in its full horror".

Mr. Harrison has written an excellent introduction to the trial, in which he reviews the more important English contributions to the discussion of witchcraft and some of the leading cases before 1612, incidentally doing justice to the too often neglected "Daemonologie" of King James I. The book is beautifully produced and does credit to its publisher.

Foraminifera.

Foraminifera: their Classification and Economic Use. By Dr. Joseph A. Cushman. (Cushman Laboratory for Foraminiferal Research: Special Publication, No. 1.) Pp. iii + 401. (Sharon, Mass.: Cushman Laboratory for Foraminiferal Research; London: Thomas Murby and Co., 1928.) 22*s.* 6*d.* net.

THAT the time has come when an exhaustive work upon the classification of the Foraminifera fills a want which has grown yearly more persistent since Frederick Chapman's book[1] went out-of-print, there can be no question. Dr. J. A. Cushman, whose persevering energy, amazing industry, and colossal output cannot but fill older students of the group with mingled admiration and alarm, has made a noteworthy effort to satisfy this want, but whether his revolutionary methods in the matter of classification, his resurrection of long abandoned, if ever adopted, nomenclature, and the overwhelming avalanche of new genera and species with which he and the workers in his "Laboratory of Foraminiferal Research" have swollen the already overburdened catalogue, will be received with equanimity by workers on the eastern side of the Atlantic, is open to doubt. In C. Davies Sherborn's colossal and epoch-marking "Index", more than twenty thousand named species and varieties of Foraminifera are recorded with an accuracy which is final; these are extracted from the two thousand books and papers listed in his "Bibliography" of the group, and these two works, which must ever remain the fundamental 'tools' of all systematic researches upon the subject, were published respectively in 1888 and 1893–96. Since then many hundreds of papers great and small have been published, and the catalogue has necessarily been vastly extended by the establishment of new genera and several hundred new species. Now comes Dr. Cushman with a work in which the index of genera alone cites more than seven hundred and fifty genera, of which less than one hundred and fifty may be regarded as synonyms. It causes the brain of the beginner to reel and his senses to gape.

The question must at once arise: What is the *raison d'être* of this magnificent volume of four hundred pages and fifty-nine plates—without counting tables and text-figures? The answer is to be found in the opening paragraph of the Introduction: "The Foraminifera have come to have a place of economic importance as well as of general scientific interest. Their use in geological correlation, especially as an aid in determining sub-surface structures in connection with petroleum investigations, has become wide-spread." This is the key-note of the book, or, as the author's fellow-countryman might say, "the nigger in the woodpile". Deposits of Foraminifera have taken their place side by side with metalliferous strata as determining factors in swaying the stock exchanges of the New World if not of the Old. As Dr. Cushman has put it in a 'broadcast lecturette', "All industry is run by oil, and oil comes from fossils".[2]

The present reviewer neither contests nor deplores

[1] "The Foraminifera." London, 1902.

[2] "Fossils: what they are." (Nat. Hist. Radio.) *Scientific Monthly*, vol. 27, p. 346. October 1928.

this condition of things: he merely records it. The paramount value of this exhaustive work lies in the fact that out of his intensive and ubiquitous study of the literature, Dr. Cushman has recorded practically everything that has ever been written upon the group—life-history, bionomics, fabric, and protoplasmic body. From this he passes to the collection and treatment of Foraminiferous material, both recent and fossil; technique (that is, methods of study, mounting, and preserving); identification and diagnosis of species. No student embarking upon the study of the group can dispense with this admirable résumé of hitherto recorded knowledge and experience.

The thirty pages of analytical bibliography form an invaluable supplement to that of Sherborn. It is when we reach the sections dealing with economic use, geographical and geological distribution, and classification, that we begin to be assailed by doubt. The case was stated shortly by J. J. Galloway in 1926[3] as follows: There are certain 'Index fossils' that connote strata (for example, *Fusulina* for the Permian, *Lepidocyclina* for the Oligocene, and so on up to Recent), and 'guide fossils', of which "those of restricted range and frequent occurrence are the *ne plus ultra* of criteria for the correlation and identification of horizons. Every worker will decide upon his own, and Foraminifera are vastly superior than [*sic*] Mollusca, being far more numerous and less liable to damage and destruction." In a later paper, Schenck[4] directs attention to the value of Foraminifera as an indication of the temperature-conditions under which the deposits were formed. Dr. Cushman himself, in the 'lecturette' already quoted, likens the strata to floors in an apartment-house with their inhabitants; "each 'floor' has its own fossils, so, if you see what are upon the surface, you know how many 'floors' you have to go down, to reach the 'floor' whose fossils connote oil". It will be observed that a strict geological 'conformity' is assumed—it may be suggested that uncharted un-conformities or 'faults' may seriously embarrass the 'petroleum geologist'. It is also self-evident that the pelagic Foraminifera must be useless as stratigraphical indications, whilst no one will contest the fact that an assemblage of Foraminifera often forms a definite facies in a horizon.

The reviewer's most serious quarrel with the author is his resurrection of names never adopted, or long ago abandoned, in accordance with the strict rules of priority in nomenclature. He was on the spot and should have strenuously stood out for the placing of such works as that of Denis de Montfort (1808),[5] whose only recognised and adopted genera are *Reophax* and *Peneroplis*, upon an Index Expurgatorius. In accordance with the strict rules of priority, we are ordered to abandon *Polystomella* (Defrance, 1822) in favour of *Elphidium* (Montfort, 1808), and *Nonionina* (d'Orbigny, 1826) in favour of *Nonion* (Montfort, 1808), the latter, curiously enough, in spite of the fact that *Nautilus* (*Nonionina*) *asterizans* (Fichtel & Moll) and *Nautilus* (*Nonionina*) *pompilioides* (F. & M.) appear as *Florilus* and *Melonis* several pages earlier in Montfort's work than *Nonion*, which is the 'new' name for *Nautilus incrassatus* (F. & M.), which, excepting in Wood's "Index" (1825), has never been heard of again, whilst, until resuscitated by Dr. Cushman, *Florilus*, *Melonis*, and *Nonion* have not been heard of for more than a hundred years. It would be interesting to know whether Dr. Cushman has examined de Montfort's types and fixed their determination. So far as the present reviewer is aware, they are non-existent.

All these 'words' were duly recorded in 1893 by Sherborn, who signified what they appeared to represent but wisely regarded them as of no systematic value. The irony of the situation is increased by the fact that these generic names have no zoological value *per se*, and their present resuscitation and acceptance is entirely owing to their precedence in printed order in Montfort's treatise. We should be grateful that Dr. Cushman is precluded by the 'Rules' from asking us (following the late Prof. Rupert Jones) to abandon *Vaginulina* (d'Orbigny, 1826) in favour of *Strombites* (Gesner, 1565),[6] which Rupert Jones identified as *Vaginulina lævigata* Roemer! It is probably too late now to protest and plead for a reaction, but it seems to the present reviewer that these cases are covered by the recently published "Opinion No. 107" (NATURE, Aug. 17, 1929) of the International Committee on "the principle that a name in current use is not to be supplanted by an earlier but rarely adopted or an unadopted name unless the argument is unambiguous", etc. The Committee should be urged to establish the records set forth in Sherborn's "Index" as the basis of departure for Foraminiferal nomenclature, and to let the hitherto universally adopted names there recorded stand, notwithstanding any later or future discoveries in forgotten or abandoned works.

[3] "Methods of Correlation by means of Foraminifera", *Bull. Amer. Assoc. of Petroleum Geologists*, vol. 10, p. 562, June 1926.
[4] "The Biostratigraphical Aspect of Micro-palæontology", *Jour. of Palæont.*, vol. 2, p. 158, June 1928.
[5] "Conchyliologie systématique." 2 vols. Paris, 1808–10.
[6] "De omni rerum fossilium genere", Tiguri, 1565, fol. 165 of the concluding part.

Lastly, one can but deplore the splitting up of established genera into an infinity of sub-genera. A single instance will suffice. We are invited to split up the genus *Polymorphina*,[7] starting from d'Orbigny's *Guttulina*, into A-forms, which are split up into *Globulina*, *Pyrulina*, and *Guttulina*—d'Orbignyan names long since abandoned—with sub-genera *Pyrulinella*, *Pseudomorphina*, and *Dimorphina*; and B-forms, which are split up into *Sigmoidella* and *Sigmomorpha*, with sub-genera *Sigmoidina* and *Sigmomorphina*, whilst *Polymorphina* is restricted to a small group coming between the sub-genera of the A- and B-forms.

The present reviewer has so seriously respected Dr. Cushman's invaluable work as "to nothing extenuate", but he equally seriously deplores the overloading and confusion of the already unwieldy nomenclature of the Foraminifera in this care-free and distracting manner. E. H.-A.

Transmission and Distribution of Electrical Energy.

Electrical Transmission and Distribution: a Complete Work by Practical Specialists describing Modern Practice in the Transmission and Distribution of Electricity Supply. Edited by R. O. Kapp. Vol. 1: *Overhead Lines.* Pp. viii + 239. Vol. 2: *Power Cables.* Pp. viii + 241-476. Vol. 3: *Switchgear, Part 1.* Pp. viii + 477-764. Vol. 4: *Switchgear, Part 2.* Pp. viii + 765-1003. Vol. 5: *Sub-Station Work, Part 1.* Pp. viii + 1005-1276. Vol. 6: *Sub-Station Work, Part 2.* Pp. viii + 1277-1563. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 6*s.* net each.

THIS work, which is published in six volumes, describes modern practice in the transmission and distribution of electrical energy. It contains much novel matter and is written by practical specialists. The first volume is divided into four sections. The first three deal with the construction, erection, and maintenance of overhead lines, and the last deals with distribution in rural areas. In the first section good descriptions are given of the poles, steel tubes, and lattice towers that are employed to support the overhead wires, and of the various types of conductors and insulators that are used. The latest data about steel cored aluminium are given, so that they can be substituted in the catenary formulæ. We were interested in the various forms of bird guards described. Incidentally, the insulated perches save the lives of the birds, but that is not the reason why they are erected.

[7] "A Revision of Polymorphinidæ", *Jap. Jour. Geol. and Geog.*, vol. 6, p. 79, 1929 (with Y. Ozawa).

The maintenance of the line necessitates having a staff of patrol men. Each patrol should have No. xii. binoculars and a self-contained focusing spot light so that incipient faults can be early detected. The section on distribution in rural areas is well written and will be a real help in solving a difficult and pressing problem.

In the second volume, the manufacture of power cables, cable-laying methods, underground cables, and consumers' connexions are discussed. We were interested to learn that it is not usually worth while to attempt the recovery of cables which have been laid direct in the earth, as the cost of recovery is often greater than their scrap value. We were also interested to find that in situations where leakage currents from tramway systems—the Germans call them 'vagabond currents'—are known to be prevalent, means should be taken to prevent leakage corrosion of the lead sheaths. If the lead sheath is covered (served) with compounded tape or jute yarn, then it will be protected from corrosion. As vagabond currents must be flowing from the central stations in various districts, watch should be kept for signs of electrolytic corrosion in lead pipes.

In the third volume, the apparatus used when controlling the enormous amount of energy generated in a modern power station is discussed. It will be helpful to junior engineers. Vol. 4 deals with the care of switchgear. On the smooth working of these devices depends the continuity of the supply and in some cases the safety of human life. A good description is given of the ironclad gear used in mining work and of the methods used to protect alternating current mains.

Vol. 5 of the work deals with sub-station practice. The modern trend of electrical development is in the direction of making every operation connected with the running of the station practically automatic. In a large electricity supply station there are usually a large number of automatic sub-stations. Some of these are simply transformers for raising or lowering the pressure. In this case they are pure outdoor stations and the transformers and switches have to withstand rain and snow storms. They sometimes have high pressure terminals and so they have to be carefully railed and only officials can have access to them. Other sub-stations are for running machinery, as, for example, rotary converters; in this case the machinery must be placed under cover. When the automatic sub-station consists of mercury vapour rectifiers, the machinery is contained in a building.

The automatic sub-stations are divided into

groups or 'areas', and a junior engineer has charge over each group. A group is divided into 'districts', each of which is under the charge of two attendants, who work in two shifts—one from 7 A.M. to 3 P.M., and the other from 3 P.M. to 11 P.M. The morning period is best for shutting down the plant for cleaning purposes. During the evening shift the attendant visits each sub-station in turn, carefully inspecting it, and at the right times switching on the apparatus required for the peak load demand. Special care has to be exercised, for there is much greater risk of something going wrong than in a manually operated station. Cleanliness of the station plant is of vital importance, and the attendant is responsible for seeing that labourers allotted to him run no risks. Automatic control can now be supplied to almost every type of converting and transforming plant, and hence considerable economies are effected by saving operators' wages.

Pure Mathematics.

(1) *A Course of Pure Mathematics.* By Prof. G. H. Hardy. Fifth edition. Pp. xii + 455. (Cambridge: At the University Press, 1928.) 12*s.* 6*d.* net.

(2) *The Elementary Differential Geometry of Plane Curves.* By R. H. Fowler. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 20.) Second edition. Pp. ix + 105. (Cambridge: At the University Press, 1929.) 6*s.* net.

(3) *An Elementary Treatise on Differential Equations and their Applications.* By Prof. H. T. H. Piaggio. (Bell's Mathematical Series: Advanced Section.) Pp. xviii + 256 + xxvii. (London: G. Bell and Sons, Ltd., 1928.) 12*s.* net.

THE technical use of the term 'limit' in mathematics retains much of the original meaning of the Latin *limes*, a boundary line, from which it is derived. The notion of limit is also a boundary in another sense, for it marks the frontier between elementary and higher mathematics, where the adjectives must not be taken as necessarily synonymous with easy and difficult. The student who arrives at this frontier has before him an important choice of routes. One route leads to an introduction of limits by an appeal to geometrical intuition by means of which, if the illustrations are judiciously chosen and if the language is sufficiently vague, most of the theorems of the calculus can be deduced with a generality which is almost embarrassing. Advance by this route may seem to be rapid, but the cost is a mistrust of mathematical processes which appear to lead to paradoxical results. The other route proceeds to a somewhat longer but rigorous building of foundations on a secure arithmetical basis. The start may be fairly arduous but the reward is a feeling of security founded on understanding. That there is an increasing tendency to realise the value of the more rigorous treatment of foundations is evidenced by the above three books, for (1) is in its fifth edition, while (2) and (3) are in their second.

(1) No introduction to the theory of functions of a real variable can dispense with a discussion of the domain of that variable—the real numbers of the arithmetic continuum. Prof. Hardy leads the student by easy stages through the concept of real number to functions of a continuous variable and so to the differential and integral calculus. Illustrations are freely given and a wide selection of examples. The book is interesting to read and places the elements of the subject on a secure basis for further advance. An appendix to the new edition explains the symbols O, o, $\sim$.

(2) A rigorous treatment of elementary plane differential geometry (curvature, contact, envelopes, singular points, asymptotes), with occasional excursions into three dimensions. It is a pity that Mr. Fowler did not incorporate Neville's revised theory of envelopes which is based on a new definition of characteristic points, the scope of which is indicated in the preface. It would have been kinder to include definitions of symbols such as O and $\sim$, instead of referring the reader elsewhere. The value of this book lies in giving a treatment of geometry in English on the lines of several French works, for example, Goursat's "Cours d'analyse".

(3) This is a really good book, which should appeal to all who embark on the study of ordinary and partial differential equations. The mathematical equipment demanded is not extensive and the subject is treated in a sane and exact manner, with copious illustrations. The chapters on numerical approximation and integration in series are very well written. The examples, which are numerous, contain many important results. In the new edition, a long chapter has been added, introducing among other things a brief note on Schrödinger's wave equation and some recent work of Remes on numerical approximation.

These three books together form a most suitable introductory course on the analytical side of pure mathematics.

L. M. MILNE-THOMSON.

Our Bookshelf.

Analytical Chemistry. Based on the Text of Prof. F. P. Treadwell. Translated, enlarged and revised by Prof. William T. Hall. Vol. 2: *Quantitative Analysis.* Seventh edition. Pp. xiii + 848. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 30*s.* net.

THE seventh edition of this work embodies quite a number of alterations and extensions of the methods in the earlier editions, as, for example, the determination of titanium in steel and in ferro titanium, Moser and Niessner's separation of beryllium from aluminium, the determination of vanadium, the use of potassium phthalate in standardisation. It would have been useful to have an account in this work of some of the more recent methods of determination of metals by means of pyridine-thiocyanate, or the useful pyridine method of separating iron from manganese, and the utilisation of thorium salts for determining fluorine.

The outline of the course of instruction beginning at p. 757 is intended primarily for students of the Massachusetts Institute of Technology, and as regards the problems given it has a wider utility; but much of the course is rather too parochial for general use. Many of the exercises set in this section, especially those dealing with potentiometric titrations, cannot be dealt with from the information supplied in the text, and require reference to other works. It is much to be desired that the use of the form of burette illustrated in Fig. 103 with the rubber tubing and bead should be discouraged as being obsolete and inaccurate.

There are few printing errors, but Problem 1 on p. 789 does not appear to have a meaning. On p. 753 the factor for titanium does not appear to be corrected for the revised atomic weight. British readers need to remember that the tables connecting specific gravity and weight per gallon refer to the U.S. gallon of 8·34 lb. Despite these minor criticisms, this work maintains its reputation as one of the most trustworthy text-books of quantitative analysis available to the chemist, and it is indispensable. J. J. F.

The Profession of Engineering: Essays. Edited by Dugald C. Jackson, jr., and Prof. W. Paul Jones. Pp. ix + 124. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 7*s.* 6*d.* net.

THE object of this book is to give a broad "and yet detailed conception of the profession of engineering". We are told in the preface that "It may be used as a text for freshman orientation". It contains nine short articles on engineering by very eminent Americans, including the President of the United States. But if it is intended to recruit the engineering profession by its means, we are afraid it will not be successful, at least in Great Britain. It lacks in many places the human touch required to rouse the enthusiasm of youthful students.

One of the best of the essays is by John Hays Hammond on "The Chemical Engineer". He points out that however wonderful a process found out in a laboratory may be, it can have little usefulness in industry until it is put into practice economically enough to make it worth while both to the buyer and the person who puts it on the market. It is the function of the chemical engineer to do this. The essay concludes as follows: "The chemical engineer stands to-day on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world".

The final article on the engineer's contribution to modern life is an address given by Herbert Clark Hoover to the American Institute of Mining and Metallurgical Engineers. He tells of his first engineering job in South Africa: of how the hard-fisted mine managers refused the offers of the young graduates for posts as assistant managers. Ultimately, some of them, including Hoover, took the job of pushing a car and pounding a drill on the wettest level of the mine at a wage of two dollars a day. In after years Hoover was grateful for this apprenticeship. He concludes by saying that we have no right to think in terms of our own generation alone: "A greater America for our children will in large degree depend on the engineering profession".

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lieferung 1. Pp. 160. (Berlin: Gebrüder Borntraeger, 1928.) 15 gold marks.

THE account of the raw materials of animal origin, of which this part is the first to be received, is to form two octavo volumes. About thirty contributors will deal with the following, among other subjects—fats and oils, wax, skins and pelts, feathers, the hard parts of vertebrates, calcareous material, excrement, sponges, ornamental material, substances used in polishing and grinding, insect galls, pigments, scents, substances used in medicine, poisons, food, and luxuries.

The present part forms the first chapter of the second volume, and gives details of the ornamental use of invertebrates or of parts thereof—the rope of spicules of the glass-rope sponge, the skeletons of Venus's flower-basket, the sertularians, Stylasteridæ, the precious coral, black coral and the stony corals, 'crabs' eyes' (gastroliths), mother-of-pearl and pearls. For most of the materials a brief definition is first given, the history of its use is outlined, the mode of origin of the material, the capture of the animal which formed it, and the preparation and further treatment of the product are described. Methods of testing the quality of the commercial article, and warning as to substitutes and imitations, are given, and finally reference is made to the commercial centres concerned in trading in the material in question; trade names and prices are stated and references to published memoirs are appended. Under 'pearls' is also given an account of the culture pearls of Mikimoto and the methods used for distinguishing these.

The work promises to be of considerable interest and use to naturalists and to business men.

Mrs. Fisher : or the Future of Humour. By Robert Graves. Pp. 95. *Diogenes : or the Future of Leisure.* By C. E. M. Joad. Pp. 102. *Romulus : or the Future of the Child.* By Robert T. Lewis. Pp. 95. *Hibernia : or the Future of Ireland.* By Bolton C. Waller. Pp. 96. (To-day and To-morrow Series.) (London : Kegan Paul and Co., Ltd. : New York : E. P. Dutton and Co., 1928 and 1929.) 2*s.* 6*d.* net each.

AN interesting literary feast is that provided in the " To-day and To-morrow " Series. A hundred 6 in. × 4 in. pages give no scope for exhaustive treatment of any subject, but the writers selected are doubtless those most capable in the main of doing justice within the defined limits. It is unsafe to generalise, but these four, out of a library approaching one hundred volumes, may be taken as representative. The chief titles lend an initial quaintness. One of the four, however, " The Future of Humour ", is deplorably lacking in this quality ; the three other selected works are entirely convincing. Mr. Joad considers the " Future of Leisure " in sympathetic style and laments the destruction of the countryside. Mr. Lewis in his " Romulus " crystallises the modern attitude towards child education. Both Mr. Waller in his thoughtful " Hibernia " and Mr. Joad may illuminate Mr. Graves in regard to true humour : " Good taste is hard to come by and easy to lose ", writes Mr. Joad, and Mr. Waller depicts the cynic admirably, to whom he attributes the view that " any man who has his hand on the tiller must also have his hand in the till ". Will the future establish the accuracy of the views expressed by these augurs in their engaging theses ? P. L. M.

The Propionic Acid Bacteria. By C. B. van Niel. Pp. viii + 187 + 4 plates. (Haarlem : J. W. Boissevain and Co., 1928.) 3 dollars.

THE increasing industrial importance of propionic acid for the preparation of esters and ketones (methylethyl- and diethyl-ketone), and for application in the cellulose industry, led the author to submit the group of propionic acid bacteria to a thorough re-investigation, the results of which are contained in this monograph.

These organisms occur in milk and other dairy products and are best obtained from Emmentaler cheese (Gruyère), in which they are responsible for the formation of the characteristic ' eyes '—bubbles filled with carbon dioxide produced as the result of the propionic acid fermentation. The bacteria, for which the author, following Orla Jensen, adopts the generic name *Propionibacterium*, are facultative anaerobes, and their characteristic chemical effect is the fermentation of lactic acid and glucose, and in some cases the disaccharides and the polyhydric alcohols, with production of propionic, acetic and carbonic acids. Acetic and carbonic acids are produced in molecular proportions from lactic acid, whilst the molecular ratio of propionic to acetic acid is about 1·8, whereas in the fermentation of glucose this ratio rises to 2-4, and from glycerol almost pure propionic acid is produced. The author considers that the manufacture of propionic acid by the action of these bacteria on glucose is a feasible proposition, the great drawback being the slow rate of fermentation. His monograph will supply any prospective manufacturer with a large amount of information on which to base his process.

Dairy Bacteriology. By Prof. Bernard W. Hammer. (Wiley Agricultural Series.) Pp. xii + 473. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1928.) 25*s.* net.

DR. HAMMER'S book covers considerable ground in an interesting and comprehensive manner, and will doubtless be of great use to students of dairy bacteriology and dairy husbandry. It deals with the normal and abnormal microbiology of milk, cream, butter, and cheese, the methods of preservation of dairy products, and tests for quality of milk and cream. Sections are devoted to the bacteriology of evaporated, sweetened, condensed and powdered milks, ice cream and fermented milks (Bulgarian butter-milk, Acidophilus milk, etc.). The subject of butter cultures (' starters ') is well treated, and the importance of the presence of the ' associated ' citric acid fermenting organisms (*Streptococcus citrovorus* and *S. paracitrovorus*) in addition to the lactic acid bacteria, is stressed.

An important section of the work is devoted to the spread of human disease through milk and its derivatives, both with regard to diseases in which the infecting virus comes primarily from the producing animals (bovine tuberculosis, Malta fever) and those in which the milk or milk products are contaminated from human sources (typhoid, diphtheria). In the former connexion the relationship between *Brucella abortus* and *B. melitensis* is gone into at some length, the two organisms being regarded as varieties of the same species and producing similar types of human infection.

R. ST. J.-B.

Cours d'électricité industrielle à l'usage des élèves-ingénieurs : leçons professées à l'Institut industriel du Nord. Par A. Defretin. Tome 1 : *L'Électricité dans la science de l'ingénieur.* Pp. xi + 582. (Paris : Hermann et Cie, 1929.) 95 francs.

THIS treatise on industrial electricity will be completed in three volumes. The first volume is divided into two parts. In the first part the general properties of fixed electrical circuits and of electrical machines are described. The style of the author is admirably clear and he takes great pains to simplify the theory. He lays stress on the importance of the student examining his equations to see that they are homogeneous, a point which is frequently neglected by industrial writers. He points out that permeability is a double valued function and explains why engineers in their formulæ adopt a constant value for it.

Instead of the ' watté ' and ' dewatté ' formerly commonly used by French writers, we have ' active ' and ' reactive ', which we think much better. Very clear line diagrams are given to illustrate the working of dynamos and alternators. Photographs of parts of actual machines are kept quite distinct from the text and are shown at the

end of the book. When the student has mastered the theory, he will find it an excellent exercise to find out the function of the various parts of the machines shown. A good description is given of mercury vapour rectifiers, both single phase and polyphase. Quite a satisfactory and useful theory of their working is given, relations being found between the power expended, the voltages, and the currents.

Colour and Colour Theories. By Christine Ladd-Franklin. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xv + 287 + 9 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 12*s.* 6*d.* net.

THIS book gathers together the scattered records of the life-work of Dr. Ladd-Franklin on the subject of colour vision, and thereby enables the value of that work to be more readily assessed. Possibly the best short indication of the nature of that work and its accompanying battles is supplied by the author herself in her review of Parsons' "Colour Vision": "The very discreditable state of Colour discussion . . . may be summed up . . . in this way:

Helmholtz. *Hering.*

Trichromatism is a fact. Tetrachromatism is a fact.

"These are evidently two absolutely contradictory statements, but both are true. *Que faire?* At this point I felt myself obliged to interfere, with (1) a reformed terminology, and (2) an adequate colour theory. I substitute for the above two statements this:

The Development Theory.

"*Tri-receptorism* is a fact and tetrachromatism is a fact, and these two facts are reconciled in the development colour theory—. . . ." R. J. B.

The Child's Conception of the World. By Prof. Jean Piaget. Translated by Joan and Andrew Tomlinson. (International Library of Psychology, Philosophy and Scientific Method.) Pp. ix + 397. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 12*s.* 6*d.* net.

PROF. PIAGET herein gives the next step in the attempt to interpret the results of the painstaking investigations in child psychology carried out at the Institut Rousseau. The problems here dealt with are distinct from those dealt with in his "Studies in Child Logic", and will be followed by a further volume dealing with the "child's physics and the analysis of the explanations children give . . . concerning the detail of phenomena and the way in which transformations and movements take place".

The book is divided into three parts under the heads realism, animism, artificialism. In the first, the origin and growth of a child's notions of thought and dreams are dealt with. In the second we find consciousness attributed to things and the growth of the concept of life. In the third the development of ideas as to the origin of common objects, as sun and moon, trees and mountains, are followed, and the meaning and origin of child artificialism considered. R. J. B.

Über Druckschieferung im varistischen Gebirgskörper. Von Prof. Dr. Axel Born. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 7, Heft 22.) Pp. vii + 329-428 + 6 Tafeln. (Berlin: Gebrüder Borntraeger, 1929.) 12 gold marks.

THE *Druckschieferung* is interpreted as pressure-cleavage which converts clays into clay-slates and sericitic phyllites. The process is explained as the beginning of dynamo-metamorphism; the various stages, which are classified as shale, jointed mudstones, block cleavage, smooth cleavage, and fold-cleavage, and the microscopic changes in the rocks, are well described and illustrated by Dr. Born.

The monograph deals with the development of the slates in the Rhineland, Harz, and Thuringia and Bohemia. In the bibliography the only British authors included are Sharp, Hutchins, and North. A useful table gives some equivalent terms in English, French, and German.

What is Eugenics? By Major Leonard Darwin. (The Forum Series, No. 9.) Pp. viii + 88. (London: Watts and Co., 1928.) 1*s.* net.

IN many ways this tiny volume is a more effective plea for a eugenic social policy than the same author's large work, "The Need for Eugenic Reform". The need for brevity has made him concentrate on essentials and disregard relatively unimportant considerations, while the style is clearer and less involved. Starting with domestic animals and the selection, conscious and unconscious, to which man has subjected them, he leads the reader on naturally to consider man himself as fundamentally kin to them, the product of evolution by heredity and natural selection. The interaction of heredity and environment is explained with simplicity and common sense: and a swift glance, in the light of these biological principles, is given to the nation's racial qualities. The remaining chapters are devoted to the possibility and desirability of eugenic methods. The book is the best brief answer yet published to the question the title asks.

Le totémisme. Par Maurice Besson. (Bibliothèque générale illustrée, 10.) Pp. 80 + 60 planches. (Paris: Les Éditions Rieder, 1929.) 22 francs.

THIS book may be interesting to the French public, but it is of little value for English students, as the subject has been dealt with at greater length and with more insight and accuracy by many English-speaking writers. An example of the lack of knowledge shown is afforded by the following quotation: "If the Papuan peoples of New Guinea are not totemic, in the western part of this great island, amongst those of the eastern zone, there exist tribes organised into clans but possessing no totems and not observing taboos". The bibliography is meagre. There are 31 excellent plates, which are not referred to in the text; this is scarcely remarkable, as few have any bearing on totemism; two of the figures are upside down.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Earthquake Sounds heard at Great Distances.

THE severe earthquake which occurred in New Zealand on June 17, 1929, was remarkable for the great distance at which the sounds which accompanied the shock could be heard.

The sounds were extraordinarily loud. After the shock, people rushed out of whatever building they were in. They were calming down when these tremendous booming sounds were heard. I have heard some say that they thought the earthquake had started a new volcano, or a terrific eruption had

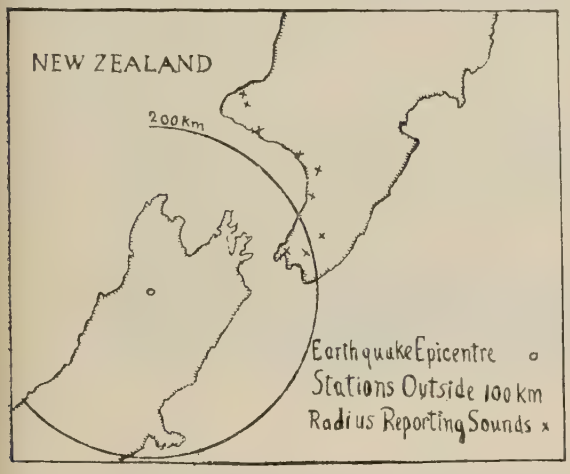


FIG. 1.—Stations at distances greater than 100 km. reporting sounds accompanying New Zealand earthquake of June 17, 1929.

taken place at the hot spring district at Taupo. In the commotion following an earthquake it is very difficult to obtain accurate figures for time elapsing between two events.

At Wellington, 165 km. from the epicentre, the sounds were heard approximately 12·5 minutes after the first earth movement was felt. The sounds were described by various observers as resembling heavy rumblings, detonations, boiler explosions, and naval gun practice. Observers gave widely differing estimates of the loudness of sounds heard, but they were sufficiently intense to add to the general alarm. The sound appeared to come from a bank of clouds to the south, in the general direction of the epicentre, and continued for about an hour.

The sounds were reported from coastal towns along the Taranaki Bight and so far north as New Plymouth (Fig. 1). Observers differed considerably about the length of time intervening between the first earth movement and the first sound. The most trustworthy data are set out below.

The epicentre and source of sound were generally believed to be at Murchison. The sounds in the area of greatest destruction were deafening and of extreme loudness, creating as great panic as the earthquake itself. Most observers described them as tremendous subterranean explosions. At Nelson, about 85 km. from Murchison, the sounds resembled the whistling and rush of wind. At Blenheim, 130 km. from the epicentre, only sounds of a local origin directly connected with the earthquake were heard. There is some indication of a zone of silence at several places 125 km. distant, but owing to the general commotion, sounds had to be comparatively loud to be heard.

TRANSMISSION TIME OF EARTHQUAKE SOUNDS.

Place.	Distance from Epicentre.	Time after Earthquake Felt.	Time after Earth Movement at Epicentre.
	km.	sec.	sec.
Wellington .	165	750	817
Orongorongo .	175	675	746
Patea . .	224	600	691
Hawera . .	239	600	698
Wanganui .	246	720	824
Stratford .	250	900	1006
Inglewood .	272	900	1011
Mean . .	224	735	828

Observers probably felt the transverse (*S*) earthquake waves, which have an approximate velocity of 245 m./s. The earth movements at the epicentre occurred within a few seconds of the accompanying explosive sounds. The time given in the last column is the computed time elapsing after the sounds started at Murchison until heard at the various stations in the Taranaki Bight. A time curve (Fig. 2) drawn from these data approximates closely to that found from great explosions. In most cases the sounds are seen to have taken longer than required if they had travelled along the surface at the normal rate of 340 m./s. in still air.

Doubtless the sound went up to a considerable height and was refracted downward either at a marked inversion in the upper troposphere or in a higher layer in the stratosphere with a marked variation of temperature or density. The average time lag agreed very closely with that which would occur from Borne's hypothesis of a change in density at high levels due to a hydrogen-helium atmosphere.

Good weather conditions prevailed over New Zealand on June 17. An intense anticyclone had been slowly advancing over the Dominion for several days prior to the earthquake. Over the Taranaki Bight the winds were south-west, force 4, and favourable for the transmission of sound to the majority of stations in Table I. Although a northerly air was blowing at Wellington at the ground, pilot balloon observations showed that at one to two km. south-west winds were blowing with an average velocity of 6 m./s. The sky was half overcast with cumulus clouds.

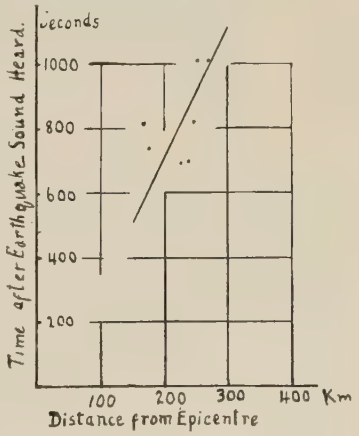


FIG. 2.

It is remarkable that sounds were not reported from points south of the epicentre. The level, thickly populated Canterbury Plains lying within a radius of two hundred kilometres were favourably situated for hearing sounds. Calms or easterly airs were recorded at all stations between the epicentre and this district.

This absence of sound suggests uneven refraction at an inversion in the troposphere. From the area of audibility it would appear that the inversion extended over the Taranaki Bight, but did not extend southward over the Canterbury Plains. The anticyclonic weather conditions which had prevailed for several days were favourable for the establishment of an inversion. ANDREW THOMSON.

Meteorological Office,
Wellington, New Zealand, Aug. 26.

MR. THOMSON'S report with regard to the sounds proceeding from the New Zealand Earthquake of June 17, 1929, is of great interest.

It is usual for sounds to be heard coming from the ground in the neighbourhood of the epicentre of an earthquake, but I have found no earlier reference to sounds transmitted through the air to great distances from such an origin.

One difficulty in understanding the phenomenon is that owing to the high velocity of sound in rocks, waves coming from below and refracted into the air must pass upwards nearly vertically. (Gutenberg, "Grundlagen der Erdbebenkunde", p. 35, gives 13° as the maximum inclination to the vertical.) No possible constitution of the atmosphere would permit the return of such waves to the ground.

Mr. Thomson remarks that the times he has computed for the passage of the initial aerial disturbance from Murchison to various places are on the average such as are found for the 'abnormal' audibility of explosions. The average time in his table is 828 seconds for the average distance 224 km. According to observations in England,[1] the time of passage of the sound from gunfire to a distance 224 km. would be about 760 seconds, that is, the delay as compared with normal transmission of sound is 100 seconds as compared with Thomson's 168 seconds. In rough estimates such a difference is to be expected. It should be noted, however, that the more accurate observations show that von dem Borne's hypothesis is not tenable. It is now believed that abnormal audibility is to be explained[2] by the high temperature of the layers between 40 km. and 60 km. above ground from which the air waves return to earth.

Mr. Thomson lays stress on the fact that the sounds were heard to the north-east of the epicentre and not to the south-west. In this connexion it may be pointed out that the earthquake occurred during the New Zealand winter and that transmission to north-east in the southern hemisphere is analogous to transmission to south-east in the northern hemisphere.

According to War-time experience, the firing on the Western Front was heard in England in summer, in Switzerland in winter. It appears that in our part of the world the zone of abnormal audibility is to be found to the north-west of the source of sound in summer and to the south-east in winter. It is not unlikely that a similar rule holds good in New Zealand, abnormal audibility being possible to the south-west in summer and to the north-east in winter.

I hope that interest in the subject will be stimulated by the experiences related by Mr. Thomson and that an experimental investigation of the transmission of air waves to great distances will be undertaken in New Zealand. F. J. W. WHIPPLE

Kew Observatory, (Superintendent).
Richmond, Surrey, Oct. 15.

[1] Int. Research Council. Commission on Solar and Terrestrial Relationships. 2nd Report, 117; 1929.
[2] NATURE, **111**, 187; 1923; **118**, 309; 1926.

Vacuum Spark Spectra in the Extreme Ultra-Violet down to 100 A.

USING a vacuum spectrometer for the extreme ultra-violet, designed by Prof. M. Siegbahn and built in this laboratory, we have succeeded in obtaining and measuring optical spectra down to 100 A. Especially in the region below 600 A., the increase in intensity and dispersion is considerable. A single exposure (time of exposure 5-15 min.) on a Schumann plate 260 mm. in length gives the region up to 1250 A. with dispersions of 3·5 A./mm. at 100 A. and 6·5 A./mm. at 1000 A., a concave grating on speculum metal with 571 lines per millimetre being used.

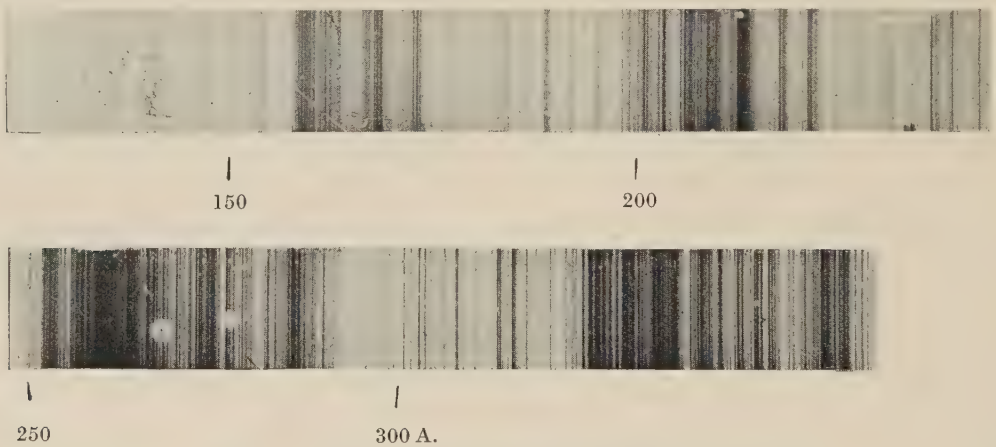


FIG. 1.—Spark spectrum of copper (lower end). Enlarged 4 times.

On a spectrogram of copper (Fig. 1) taken with a slit width of 0·005 mm., all the lines given by Millikan (Millikan and Bowen: *Phys. Rev.*, **23**, p. 1; 1924) down to 155·7 A. are found as intense line-groups. Our measurements on this element extend to 126 A. and include about one hundred and forty lines below 200 A.

An investigation of the lighter elements from lithium (3) to fluorine (9) has revealed hitherto unknown spectral series of highly ionised atoms. The lines reported by Millikan and Bowen are generally found within their limits of error. Especially below 400 A. they are, however, separated into two or more components. But we have not been able to check the lines at 136·6 A. and 144·3 A. ascribed by Millikan to oxygen, which have hitherto been considered as the shortest wave-lengths measured in optical spectra.

Starting from the hydrogen line at 1215·68 A., a system of wave-length standards has been determined, extending to 192 A., in very good agreement with the measurements by Bowen in the region above 500 A.

In the spectrum of Li II we have measured the first three lines of the principal series $1\,S - m\,P$.

Li II.	λA.	ν.	$m\,P$.	$1\,S$.
$1\,S - 2\,P$	199,263	501849	108263	610·112
$1\,S - 3\,P$	177,99	561829	48330	610·159
$1\,S - 4\,P$	171,54	582954	27247	610·201

The P-terms are those given by Werner from higher series (Copenhagen 1927).

Taking $610{\cdot}112 \pm 100$ cm.$^{-1}$ from $1\,S - 2\,P$, which is a mean value from four spectrograms, we get for the ionisation potential of Li II

$$610{\cdot}112 \times 1{\cdot}2339 \times 10^{-4} = 75{\cdot}282 \pm 0{\cdot}012 \text{ volts.}$$

We have also obtained the first line of the corresponding series for Be III, thus extending the ultra-violet spectrum to 100·25 A. Though the ratio of grating-space to wave-length is about 180, the line

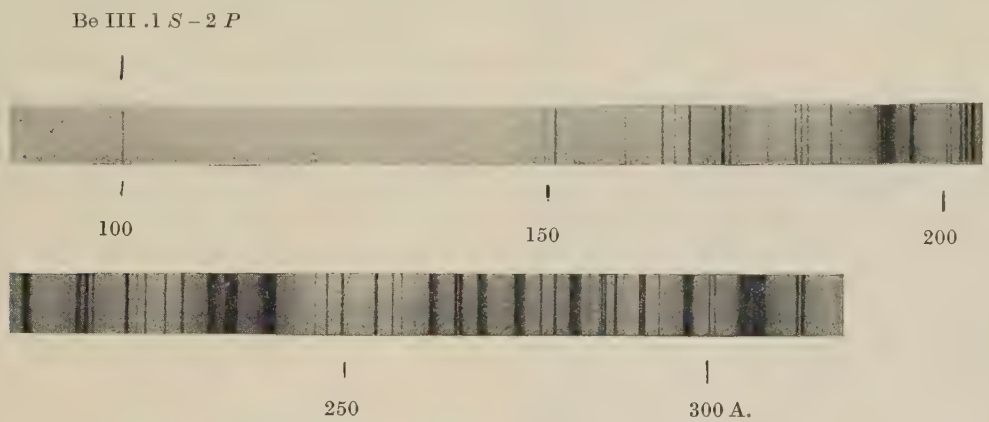


FIG. 2.—Spark spectrum of beryllium (lower end). Enlarged 4 times.

appears extremely sharp (Fig. 2). The spectrum of Be III was hitherto unknown and the $2\,P$ term undetermined.

If we extrapolate $2\,P$ from He I and Li II, we have

$$2\,P = 243{\cdot}263 \pm 500 \text{ cm.}^{-1},$$
$$1\,S - 2\,P = 997{\cdot}506 \pm 300 \text{ cm.}^{-1},$$

and

$$1\,S = 1240{\cdot}769 \pm 800 \text{ cm.}^{-1}.$$

From this we calculate the ionisation potential of Be III to be $153{\cdot}10 \pm 0{\cdot}10$ volts.

In closing this brief preliminary report, we may recall that Mr. Söderman, working in this laboratory, recently followed the X-ray K-series of the lighter elements down to and including beryllium. The $K\alpha$ line of this element as given by Söderman extends from 111 A. to 122 A. with its maximum at 113·4 A. It is interesting to note that the optical spectra and the X-ray spectra of the same element thus overlap each other.

BENGT EDLÉN.
ALGOT ERICSON.

Physics Laboratory, University, Upsala,
Sept. 20.

Natural Selection.

MY letter on "Natural Selection", which appeared in NATURE of Aug. 10, has provoked comments from three correspondents, namely, Prof. Garstang, whose letter appeared in the issue of Sept. 14, Mr. J. B. S. Haldane, whose letter was published on Sept. 21, and, lastly, Prof. Poulton, in his letter in the issue of Oct. 12. I should like to deal with all three letters at the same time.

1. Prof. Garstang's letter appears to me to be trivial and not to touch the main point at issue. Let me briefly restate this principle. When a man builds a house he is the selector of the materials, and his mind guides the selection. In so-called 'natural selection' there is no selector: when an animal is 'selected', all that is meant is that it is there—if we ask why it is there, the answer is that it 'fits the environment'; if we inquire further why it fits the environment, we are told 'because it is a favourable variation'; if now we seek to discover what produced the favourable variation we are told 'the environment' ('conditions of life', Darwin), *therefore the surviving organism is the one which reacts best to the environment*, which was my point. For the rest I commend with confidence Prof. Garstang's letter, both as to logic and taste, to the judgment of readers of NATURE.

2. The thoughtful and reasonable letter of Mr. Haldane deserves a more detailed answer, which I shall give as briefly as possible.

Mr. Haldane asks whether, when I reject natural selection as a cause of evolution with one hand, I am not accepting it with the other, when I say that the most vigorous survives. Did not Darwin talk of the 'survival of the fittest'? My answer is, No! The two statements are not equivalent. 'Fitness' in Darwin's mouth meant any chance correspondence between an idiosyncrasy of an individual organism and the environment. Vigour, on the contrary, denotes a *certain level of intensity of life* which is essentially the same thing in all *organisms where it occurs*. This intensity connotes the efficient performance of all the vital functions, including the *function of growth*; and it is through this last function that the organism acquires all its characters including those that distinguish it as an individual from its fellows of the same race; these are the so-called 'fluctuating variations' of Darwin. Natural selection then, in weeding out the less vigorous, leaves to survive those in whom growth and other functions are most healthy, and only these realise to the full the typical characters of the species. Consequently by it the species is kept true to type and healthy, but nothing new is produced. Of course, if we make the further assumption, that if the environment changes then the vigorous individuals respond to the change by new habits of growth, then I agree, only this is not Darwinism but Lamarckism.

Mr. Haldane further complains that I reject mutations as 'pathological'. Under this head I included those deviations from type which do occur rarely in Nature, and frequently turn up in the farmyard and

garden, and have been the subject of intensive study on the part of geneticists. 'Pathological' perhaps conveys a slightly wrong impression, but if I say that *all mutations are the outward sign of inward constitutional weakness* my meaning will be clear. To give all the evidence in favour of this view would occupy too much space—the recent experimental results all point in this direction. I think that the most unexpected and dramatic support for this position came from Mohr, a distinguished geneticist, in an address delivered to the Genetic Society about two years ago, at which, so far as my memory serves me, Mr. Haldane was not present. Mohr compared the mutations of *Drosophila* to the colours of the spectrum. At the red end there were the (imaginary) 'modifying factors', which produced no effect by themselves on the appearance of the animal, and did not impair its vigour. As one passed towards the blue end the mutations produced visible changes in form and lessened the viability until the sub-lethal mutations were reached corresponding to the violet rays, which entailed the almost certain death of the individuals embodying them. Therefore, since mutating individuals are always the least vigorous, they can have played no part in the foundation of natural species; in a word, they have had no part in evolution. This view was also endorsed by the late Dr. Bateson in my laboratory about one and a half years before his death.

I fail utterly to see the relevance to this question of the Russian experiments quoted by Mr. Haldane. That of two wild varieties brought into cultivation and planted together, one should kill out the other is exactly what I should expect. That this result should be due to the fact that one was better suited to the new environment I gladly concede, but this 'suiting' was the result of habits of growth and metabolism slowly acquired by the species in the age-long response of vigorous individuals to their natural environment.

But, says Mr. Haldane, vigour is controlled by Mendelian 'genes'. I envy Mr. Haldane his child-like faith in the Mendelian genes. Mendelian genes are abstractions which exist in the mind of the geneticist *and nowhere else*. Mr. Haldane, who is a most able mathematician, knows very well that by properly choosing your genes any conceivable difference between two races or mutations can be made to fit. As an old Oxford 'greats' man, he is also well aware that a proof of the validity of the Mendelian scheme attained in this way is not worth the paper it is written on.

I cordially agree with Mr. Haldane that physiological differences are the really decisive factors in the survival of species. I hope to live to see a rational quantitative explanation of these differences in vigour put forward—not an explanation in terms of imaginary and undemonstrable 'genes'.

Mr. Haldane's concluding statement fills me with amazement. He suggests that the random crossing of different genes distributed throughout wild species may supply the material on which natural selection may act. Suppose that we grant for a moment that genes are realities; then the crossing of the genes existing in a species would give a limited number of combinations; selection amongst these would leave only a few surviving, and when this had been done no further evolution would be possible. If he says that new genes arise, then this is equivalent to saying that new variations arise; and we shall have to inquire what are the causes of these new variations, and the whole question is in the melting-pot again. The mutations of the farmyard and garden certainly will not help us, and for an example of the bankruptcy of any attempt to apply the 'gene' theory to explain the difference between two natural local races I recommend to Mr. Haldane a close study of Goldschmidt's work on the geographical races of *Lymantria dispar*.

3. Prof. Poulton, from whom it is a pleasure ever to differ, and with whom it would be a joy to agree, deals chiefly with the question as to how far adult butterflies are attacked by birds. On this subject I do not profess to be an expert; in my original letter I quoted the opinion of Bergh, who claimed to have made an exhaustive investigation of the subject, and he could find little evidence of such attacks. Prof. Poulton is probably more nearly right than Bergh was, though I must say that the additional evidence which he brings is not overwhelming. But the real point is this; even if Prof. Poulton could prove—and he is much too honest to claim this—that certain butterflies escaped being eaten because their wings had a certain pattern of pigment, this would throw no light on the process by which they acquired this pattern. In the days of Prof. Poulton's youth, and of my boyhood, to prove an evolutionary series all that was regarded as necessary was to arrange a series of living organisms in a series. We have outgrown this crude reasoning: the course which evolution has pursued can be determined with almost absolute certainty in a few special cases: (*a*) by lineage series in palæontology; (*b*) by the close comparison of allied subspecies or races; (*c*) by the study of individual development. It is from the study of cases like these that the laws of 'evolution' should be deduced; and when anyone of these cases has been successfully analysed, evolution has been found to resolve itself into 'slow functional change'.

E. W. MACBRIDE.

Imperial College of Science,
South Kensington,
London, S.W.7.

The Scattering of Light in Colloidal Solutions and Gels.

THE scattering of light in colloidal solutions is a fundamental property, which depends upon the size, shape, and nature of the colloidal particles, and is therefore expected to reveal the intimate changes taking place in those systems under different conditions. I planned about three years ago to investigate the different colloidal-chemical problems by a systematic application of the light-scattering technique. Some of the problems which have been so far investigated are: (1) the mechanism of the formation of colloidal solutions from molecularly dispersed material; (2) phenomena like the ageing and coagulation of sols; (3) studies in soap solutions and gels; (4) mechanism of the swelling of gels, and so on.

The investigations consist essentially of the measurement of the intensity and depolarisation of the scattered light, combined with an ultramicroscopic examination (wherever possible), and a study of other physical properties.

One of the systems first studied was agar sol, and some of the results obtained have been published already (*Proc. Roy. Soc.*, **122** A, p. 76; 1929). The other systems investigated include gelatin and silicic acid sols and also soap solutions. Some of the interesting results obtained are briefly given below:

(1) The mechanism of the formation of silicic acid sols by the hydrolysis of methyl silicate has been investigated by following the changes in the intensity of the Tyndall light with time. The results indicate that primary particles are formed at first and that these form bigger aggregates after some time.

(2) The changes in the light-scattering capacity during the ageing of silicic acid sols have also been

studied. The time – Tyndall intensity curves are quite regular and distinctly *S*-shaped, being at first convex to the time axis and concave towards the later half. The results could be explained both qualitatively and quantitatively by assuming that ageing consists of the slow aggregation of colloid particles, and that the formation of these aggregates, upon which the increase in the intensity of the Tyndall light depends, is determined by two factors—(*a*) an increase in the number of effective collisions between the particles, probably due to a slow decrease in their charge, and (*b*) a continual decrease in the number of the original particles, which causes a corresponding decrease in the rate of formation of the aggregates.

(3) The results obtained with gelatin sols (at the iso-electric point) are very similar to those of agar sols (loc. cit.). The following view is suggested to explain the results : Gelatin sols have been considered to be polydisperse systems in which part of the gelatin is present in the molecularly dispersed condition, and the rest as polymolecular micells. The extent to which a particular sol is molecularly dispersed depends upon its concentration and temperature. In weak gelatin sols (less that 0·5 per cent) the gelatin is molecularly dispersed to a large extent. When such a sol (at the iso-electric point) is cooled below 25°, the intensity of the scattered light increases rapidly, whereas the depolarisation factor first decreases, after which it increases. The explanation suggested for this phenomenon is that, as the molecular aggregates are formed, their spherical symmetry also increases. It may be interesting to mention that Mr. S. R. Rao (*Ind. Jour. Physics*, September 1928) observed a similar effect, namely, a decrease and a subsequent increase in the optical anisotropy as the molecular association of liquids like propionic and butyric acids increases.

(4) In the case of soap solutions (of which sodium oleate is taken as a typical case) some interesting results have been obtained. When a 0·5 *N* sodium oleate solution is cooled from 80°, there is only a slight increase in the Tyndall intensity until about 25° ; but below 25° the intensity increases rapidly. The lower the temperature the more rapid is this increase. This suggests that lowering the temperature causes a supersaturation of the solution, and hence the sodium oleate is condensed in the form of colloidal particles. This view is further supported by the recent work of Dr. Thiessen, who found that the formation of particles on suddenly cooling sodium oleate solutions obeys a law similar to that found by Prof. Tammann in the case of the formation of nuclei from supercooled liquids.

Further, the temperature – Tyndall number curves do not follow the same course during the initial cooling and the subsequent heating of the sodium oleate solution ; that is, they show *hysteresis*, very similar to that observed by me in the case of agar and gelatin sols. The variation of the depolarisation factor (θ) when the solution is cooled shows a striking similarity to that observed with gelatin and agar sols, namely, a marked decrease in θ at first and afterwards an increase. This indicates that we are here concerned with the formation of molecular aggregates, which have a greater spherical symmetry than the original molecules.

One of the interesting points discovered by Prof. McBain and Miss Laing is that the conductivity and the osmotic activity of a sodium oleate solution are unaffected when it sets to a clear gel. From this they conclude that the colloidal particles in the sol and gel must be identical in nature and amount. A more significant property of colloidal solutions is their light-scattering capacity. I have found that the intensity of the light scattered by the clear gel of sodium oleate is distinctly higher than that of the sol state, thus indicating that the particles in the gel are bigger than in the sol.

A detailed account of this work will be published elsewhere. The above researches were carried out in the chemical laboratories of University College, London. I am at present carrying out an investigation in the laboratory of physical chemistry, Upsala, to see how far the above views regarding the molecular state of gelatin are supported by an ultracentrifugal study of gelatin sols. K. KRISHNAMURTI.

Upsala, Sweden,
Oct. 3.

A New Species of *Cronartium* from the Himalayas.

OF the various parasitic rusts of the coniferous trees now under investigation, one which baffled us for many years and has been a serious pest of *Pinus longifolia* Roxb., the *Chir* pine, in north and north-western India, has been recently worked out. The æcidial stage (Fig. 1) which was formerly known as

FIG. 1.—Section of *Pinus longifolia* stem showing typical æcidial sori of *Peridermium himalayense*.

Peridermium orientalis Cooke, and also as *Peridermium complanatum* var. *corticola* Barclay, has been recently redescribed as *Peridermium himalayense* Bagchee (*Indian Forest Records*, Botany Series, Vol. 14, Part 3, 1929). This fungus has caused much mortality every year not only in the plantations of Almora (Fig. 2) and Naini Tal, but has also impeded natural regeneration in Kumaon and Garwhal Himalayas, where the young pine stands appear to be doomed to eventual extermination. The infection and mortality is very severe in young crops of pine up to the advanced sapling stage, but the poles and mature trees are apparently safe from attack. The *Cronartium* stage has been discovered on *Swertia* species, of which *S. alata* Royle, *S. angustifolia* Ham., *S. cordata* Wall., appear to be very susceptible to this rust. The biological relationship of the two stages has been proved recently by cross-inoculation experiments. The detailed report of this investigation will appear in a subsequent issue of *Indian Forest Records*.

An interesting point appears in connexion with this stage of the fungus on the broad-leaved host. *Swertia* species, being annual herbs, appear soon after

the early monsoon rains, and at this time infection takes place through the æcidial spores from the diseased pine of the neighbourhood. They die off at the close of the autumn after a short span of life of about four months. On examination of the herbarium specimens at Dehra Dun, some were noticed with this rust on the leaves, specially *S. alata* and *S. cordata*. They were collected between the years 1891 and 1894 and from widely separated localities, from Bashahr, Punjab, and Jaunsar in the United Provinces. The earliest infection of pines was recorded from these divisions. The above species of *Swertia*, being native of the Himalayas, often grow in the *Chir* pine forest; if there is a diseased pine in the neighbourhood, there is a chance of infection of *Swertia* growing close by. It will be interesting to know from the historical side of the disease if some of the infected specimens have found their way to any other phanerogamic herbarium of the world. Not infrequently one can find certain fungi by looking through a collection of flowering plants in a herbarium. The species of *Swertia* carrying the *Cronartium* infection, the date of collection, and the locality, are the points which interest me.

FIG. 2.—Typical gaps (left-hand portion) caused by heavy mortality of young growth as compared with the better stocking (right-hand portion). Attempts to fill up the gaps by periodic sowings have been unsuccessful.

KRISHNADAS BAGCHEE.
Mycological Laboratory,
Forest Research Institute, Dehra Dun,
Sept. 19.

Raman Effect from Powdered Crystals.

MAY I make the following remarks concerning Mr. A. C. Menzies' letter in NATURE of Oct. 5, p. 511, on the "Raman Effect from Powdered Crystals". For several months I have been engaged in studying the Raman effect from different crystalline powders, and I can corroborate Mr. Menzies' statement that the reflection of the incident radiation by such powders is no obstacle in observing at least the stronger Raman lines. I tried several ways of obtaining Raman spectrograms, and found that the best results could be secured when the powdered crystals were filled into a rectangular plate-glass vessel of a few cubic centimetres contents, on which the light of a mercury arc was focused through one side surface, while the secondary radiation was observed by putting the spectrograph as close as possible to another side of the vessel perpendicular to that where the primary radiation entered.

The scope of my investigation was to compare the Raman spectra of different crystals with the already known Raman spectra of solutions of those crystals in some liquid. My first material was naphthalene ($C_{10}H_8$), the Raman spectrum of which is known as a liquid (cf. A. Petrikaln and J. Hochberg, *Zeitschr. f. phys. Chem.*, B **3**, 217; 1929) and as a solution in carbon tetrachloride (cf. A. Dadieu and K. W. F. Kohlrausch, *Sitzber. Wien. Akad.*, IIa, **138**, 335; 1929, and *Phys. Zeitschr.*, **30**, 384; 1929), both of which are identical. I obtained 9 lines, namely, at the wave-numbers 21,541, 21,637, 21,910, 22,170, 22,420, 23,320, 23,682, 23,950, and 24,195 cm.$^{-1}$, all of which coincide within the experimental error with already known stronger Raman lines, which have been found and classified by the above-mentioned workers. I may add that with no other substance was I so little hampered by the continuous background on the Raman spectrograms, which in this case very likely results from reflection of the primary radiation. The Raman lines came out especially clear, in fact, little less than in a solution of carbon tetrachloride.

I proceeded then to the investigation of some crystals, which, when dissolved in water, split up into ions, and I chose substances of which the solutions have already been investigated (cf. A. Carelli, P. Pringsheim, and B. Rosen, *Zeitschr. f. Phys.*, **51**, 511; 1928; R. G. Dickinson and R. T. Dillon, *Proc. Nat. Acad.*, **15**, 334; 1929). For this reason amongst the nitrates those of sodium, ammonium, and calcium were chosen. The 4358 A. mercury line, when scattered by ammonium nitrate, gives rise to two lines of almost equal intensity with wave-numbers 22,232 and 21,882 cm.$^{-1}$, corresponding to a frequency shift of 706 and 1056 cm.$^{-1}$ respectively (against 723 —weak—and 1050—strong—observed by Dickinson and Dillon). With calcium nitrate I obtained but one line with 21,884 cm.$^{-1}$, corresponding to 1054 cm.$^{-1}$ shift (Dickinson and Dillon observed 1052 strong and 723 weak). From sodium nitrate a strong line at 21,864 cm.$^{-1}$ was obtained (shift = 1074 against 1050 as observed by Dickinson and Dillon), whilst the existence of two weaker lines remained doubtful. This is the only case where I found a difference outside the experimental error between the 1050 shift in the solid state and in the solution. One large $NaNO_3$ crystal has since been examined by C. Schaefer, F. Matossi, and H. Aderhold (*Phys. Zeitschr.*, **30**, 581; 1929), and four lines were observed, which proves that the use of one big crystal, when available, is of course preferable to that of powder. The difference between the size of the shift in the solution and in the crystalline state is corroborated and fully discussed in this paper, but it seems not to exist for ammonium and calcium and also not for potassium (cf. Mr. Menzies' communication).

Of the other crystal powders investigated I can say that $NaNO_2$ gave one line at 21,605 cm.$^{-1}$, corresponding to a shift of 1333 (Carelli, Pringsheim, and Rosen observed 1303 and besides 696 and 785), and that NaCl and NH_4Br gave no lines. As a last example solid carbon dioxide may be mentioned, with which I equally failed to obtain Raman lines, although one knows by the work of Rasetti on gaseous carbon dioxide that such lines exist.

R. BÄR.
Physikalisches Institut der Universität,
Zürich, Oct. 9.

Golgi Body and Vacuome.

A SMALL piece of ovary of a very young pigeon was kept for about twenty minutes in a trough of dilute solution of neutral red, just pink in colour (strength—1/25000 physiological salt solution). It was then teased out and examined under an oil immersion lens in artificial light. The young oocytes

showed a nucleus and a thick granular mass at one end of the nucleus in the general cytoplasm (C. F. D'Hollander's " yolk nucleus of Balbiani " observed with classical methods). In this area particularly, in more advanced oocytes, could be seen the following three structures (Fig. 1).

(1) A large number of small bodies, some of which are spherical, with a clear core in the middle, and others, very minute crescent-shaped structures, embracing a little dense archoplasm (G.B.). These we identify as Golgi bodies. We get exactly similar

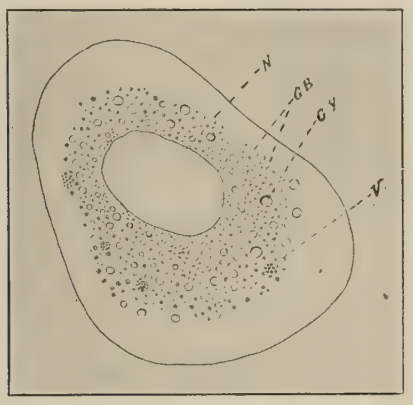


FIG. 1.

bodies occupying the same position in material fixed with silver nitrate formalin or osmic methods.

(2) Prominent and highly refractive bodies each surrounded by two or three crescents of the nature of Golgi bodies referred to above. We identify these as Golgi yolk (G.Y.).

(3) Dispersed in between the Golgi elements are groups of vesicles which take a cherry red colour with dilute neutral red, and are evidently Parat's ' vacuome' or Gatenby's ' vacuoles ' (V.).

After the red vacuoles had appeared, we added a little 2 per cent osmic acid, but observed no special change in the cells, except that the osmiophilic portion of the Golgi bodies got a little darker. *The vacuoles remained unaffected.* We then tried the reverse process, that is, we first examined the ovary in 2 per cent osmic acid solution. We could observe the Golgi bodies and refractive Golgi yolk but *no vacuoles.* On adding the dilute neutral red solution, the vacuoles appeared in about fifteen minutes. This evidently shows that the red bodies are not osmiophile and therefore are something totally different from Golgi bodies, which always respond to the well-known specific tests.

D. R. BHATTACHARYA.
R. S. DAS.

Zoology Dept., Allahabad,
Sept. 20.

Lethal Action of Ultra-Violet Light on Micro-Organisms in a High Vacuum.

IN comparing the action of low velocity electrons on micro-organisms with that of ultra-violet light, the question arose as to what the action of ultra-violet light on micro-organisms in a very high vacuum would be. It was rather expected that the lethal action *in vacuo* and in air might be different, since, in a high vacuum, the organisms are of necessity in a very dry state and in open air they may be very moist. In order to get a general idea of the lethal action *in vacuo* the following experiments were tried.

Slides of platinum and glass, coated with a thin smear of *Staphylococcus albus*, were placed in a vacuum of 5×10^{-6} mm. of mercury and exposed for various periods, through quartz, to the full radiation of a 110 volt A.C. quartz mercury arc at a distance of 24 inches. After exposure, the slides were removed from the vacuum, coated over with a thin strip of moist solid agar and incubated for from twenty-four to forty-eight hours. The results obtained are as follows:

1. *Staphylococcus albus* on glass or platinum in a vacuum of 5×10^{-6} mm. is readily killed by ultra-violet light. This may indicate that the lethal action is a direct one rather than due to some chemical change taking place.

2. Comparison of slides exposed simultaneously *in vacuo* and in air show that the lethal action in a vacuum is just as great as in air.

D. A. WELLS.
Basic Science Research Laboratory,
University of Cincinnati.

Witchcraft and the Black Mass.

IN the notice of Dr. Kittredge's " Witchcraft in Old and New England " in NATURE of Oct. 5, the reviewer says: " One of the accused gave evidence that he had carried away from Mass a part of the Host, which points to a knowledge of the ritual now known as the Black Mass ". Surely this inference is very precarious. G. G. Coulton gives numerous examples of the use of the Host as a vaguely powerful charm, quite apart from any ritual except such as is implied in the use of any charm whatever; for example, it was sometimes scattered over the fields to promote the growth of the crops. Such practices would seem to be the raw material out of which ritual is manufactured, and suggest that the Black Mass would be a later development.

H. WALLIS CHAPMAN.
Whitethorns, King's Road,
Berkhamsted, Oct. 17.

JAMES DEVICE'S statement must be taken in its context. If the Host had been required merely for the purpose of a charm, he would scarcely have been instructed to hand it over to " a Thing " which he thought would have torn him to pieces when he failed. It is, therefore, legitimate to infer something more vital to the witches' organisation. As Boguet only a few years before had had the Witches' Sabbath and the Satanic Mass under investigation, and Gaufridi's case was raising the same issue, a reference to that ritual becomes still more probable, though whether due to the witness's own knowledge or to the suggestion of his examiners remains an open question. On the Continent the existence of the Satanic ritual had been recognised for centuries.

THE REVIEWER.

Dipterous Parasites of Tsetse Flies.

IN a recent issue of the *Bulletin of Entomological Research*, Major E. E. Austen has a very interesting paper on the flies of the genus *Thyridanthrax*, which are parasitic on tsetse flies, and are the only Diptera known to be parasitic on *Glossina*. I thought at once of the species of *Glossina* fossil in the Miocene of Colorado, and of the numerous genera of Bombyliidæ also fossil in the same shales. These, or some of them, may well have been parasitic on *Glossina*, and may have had something to do with its extinction in America. It is interesting to note, however, that *Thyridanthrax* belongs to a series of Bombyliidæ little related to the fossil genera, and can have no connexion with them.

T. D. A. COCKERELL.
University of Colorado,
Boulder, Sept. 13.

Final Report on the Great Barrier Reef Expedition.

By Dr. C. M. YONGE, Balfour Student in the University of Cambridge.

THE last members of the Expedition left Low Island on July 28, 1929, one year and twelve days after the arrival there of the original party from England. We were so fortunate as to survive the year without serious illness and without damage to the huts, boats, and equipment. The original programme of work was not only completed in almost every particular but also was extended in many ways. It is also gratifying to report that the money raised (less than £9000 in actual money, though much assistance was received from shipping companies, the Queensland Government,

FIG. 1.—Map of the coast of North Queensland between Cairns in the south and the Flinders Group in the north, showing the Great Barrier Reef and principal islands, and indicating the range of operations of the Expedition.

and scientific sources, representing a considerable additional sum) proved sufficient, but only a very small sum remains for publication, and additional money will be needed for this purpose.

During the second half of the year spent on Low Island, work was extended in many directions up and down the Barrier, when the knowledge gained during the long period of intensive work on the Island enabled the fullest use to be made of comparatively short visits to other regions. Fig. 1, which shows the coast of Queensland from Cairns northward past Cooktown to the Flinders Islands, a stretch of some 200 miles, covers the regions most intensively worked, plankton and hydrographic stations, dredging stations, and reef surveys being all appropriately indicated.

In addition to their weekly station three miles east of Low Island, the boat party worked a series of stations inside and outside the Barrier at intervals between the Island and Cook's Passage. They found no notable differences in the conditions at any of the inside stations from those obtained at the regular station. An upwelling of the deeper water was found close to the Barrier face outside, oxygen saturation being little effected but nutrient salts being brought up from below. There was a notable difference in the forms of plankton taken outside. Mr. Orr, accompanied by Mr. Otter, visited Willis Island, the site of the Commonwealth Meteorological Station and some 240 miles from the coast, on the lighthouse steamer *Cape Leeuwin*, and took a series of water bottle samples during the voyage. The other work was carried out on the *Magneta*, a powerful motor launch hired from Townsville.

A series of local dredging stations was also worked with the *Magneta* and an extended cruise made as far as the Howick Islands. The rectangular dredge and the Agassiz trawl were used, and a varied and interesting collection of the bottom fauna and flora was made. The mud bottom, which is very widespread within the Barrier, is singularly deficient in life of any kind, but the sandy bottom around Lizard Island in particular is covered with a rich growth of *Halimeda*, on which lives a varied invertebrate fauna providing food for fish which there abound. Wherever there was a big tidal scour, the clean rocky bottom provided a rich, though difficult, dredging ground. Both dredging and trawling were attempted outside Cook's Passage and Papuan Pass in several hundred fathoms of water. Some material was obtained, but without an ocean-going boat equipped with suitable power winches, this type of work cannot be properly conducted. The small motor and friction winch purchased by the Expedition proved invaluable for dredging everywhere and for plankton and water samples in deep water.

The shore party, accompanied by Mr. Spender as surveyor, carried out detailed ecological surveys of Three Isles, an island resembling Low Island in many particulars, and also of portions of the Outer Barrier which was worked from Lizard Island. This latter excursion, carried out on the M.L. *Tivoli* from Townsville, was undertaken during the new moon spring tides in June, when remarkable day low tides were experienced. These coincided, fortunately, with calm weather, which alone rendered such work on the Outer Barrier possible. During these same low tides the remainder of the party at Low Island visited several of the adjacent reefs on the *Luana*. Fig. 2 gives some indication

of the wealth of coral exposed at Pixie Reef, a small coral formation which lies isolated in the middle of Trinity Opening. During the corresponding tides in July, a four-day trip was undertaken with the M.L. *Daintree* by the majority of the members of the Expedition and portions of the Outer Barrier to the north and south of Papuan Pass examined. The weather on this occasion was far from favourable, but the spectacle of the Pacific rollers breaking on the cemented outer ridge of the Barrier, on to which it was driven by a strong south-easterly gale, was of an impressive grandeur.

A party consisting of Dr. and Mrs. Yonge, Mr. Moorhouse, and Mr. Nicholls left Low Island towards the end of April and spent five weeks in the Torres Straits. The pearling industry at Thursday Island was investigated, also the work of Papuan Industries, Ltd., at Badu Island, and a fortnight was spent on Murray Island, the site of Dr. Mayor's expedition in 1913. The particular object of this trip was a survey, so far as the limited time allowed, of the marine industries in the Straits and an examination of further economic possibilities. The members of the party were especially impressed with the policy of the Queensland Government, which aims at making the Islanders self-supporting; they already run some thirty boats, cutters, and luggers, which collected a considerable proportion of the sixty thousand pounds worth of *Trochus* shell exported from Thursday Island during 1928. Dense shoals of 'sardines' (a small clupeoid) congregate around the shores of Murray Island during the daytime, dispersing at night, presumably for food, for their stomachs are always found empty during the day. They probably come inshore for protection, as they are pursued relentlessly by sharks and other predatory fish. So dense are the shoals and so easy of access, that the natives are able to catch them with

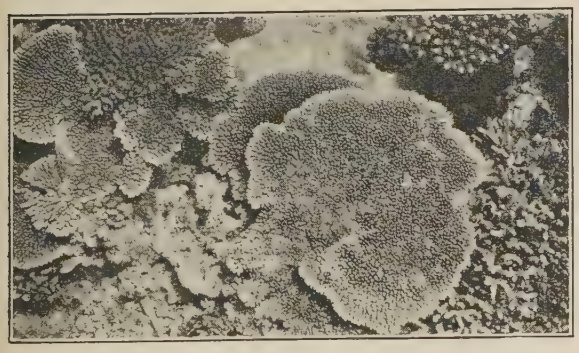


FIG. 2.—Exposed coral, largely species of *Acropora*, on Pixie Reef, taken during low water springs at the beginning of June.

multipronged spears, as many as six fish being sometimes caught with one throw of the spear. The more usual method of capture, however, is by means of a cast net, and Fig. 3 shows a typical catch. The economic possibilities of this fishery are apparent; the fish are always present, always accessible, and in practically unlimited numbers. Apart from existing fisheries, pearlshell, *Trochus*, bêche-de-mer, and turtle, there should be great possibilities in the development of a trade in cured fish with the East, while the value of dugong oil is such that a development of this fishery would probably be a sound commercial undertaking. The labour question is greatly simplified by the presence

FIG. 3.—Typical catch of 'sardines' after one throw of cast net at Murray Island.

of a highly intelligent and physically almost perfect population on the Islands.

The final excursion took place after the departure from Low Island, Miss Marshall, Mr. Orr, and Dr. and Mrs. Yonge breaking their journey south at Gladstone, whence they visited the Capricorn Islands, a series of isolated coral islands south of the true Barrier. Probably as a result of the more varied character of the winds, these islands differ considerably in character from the northern reefs, while the coral, though less rich in variety, is, if anything, more luxuriant and certainly more spectacular. The economic possibilities are considerable; there is a turtle-canning factory on Heron Island while fish are abundant, Gladstone possessing the only fish freezing and curing factory in Queensland.

The routine work on phytoplankton and zooplankton from the station three miles east of Low Island and from the lagoon were continued until the end of year by Miss Marshall and Mr. Colman respectively. Only minor fluctuations were found. Mr. Colman also investigated the vertical distribution of the plankton by day and by night, and found that the surface waters by night were five or six times as rich as by day, while the night catches contained many organisms rarely caught by day. Miss Marshall also continued her work on the production of oxygen by the planulæ of *Pocillopora* and *Porites* and found that, in the former, the production of oxygen is greatest between

9 A.M. and 3 P.M., when it just balances the loss due to respiration.

As foreshadowed by the plankton figures, Mr. Orr failed to find any significant changes in the chemical constituents of the sea, in the course of his routine analyses. He continued work on the diurnal changes over the reef flat and in the mangroves, and for a comparison with the latter worked, in conjunction with Mr. Moorhouse and Mr. Nicholls, on those at the mouth of the River Daintree and made an examination of the river itself. With the assistance of Miss Marshall on the biological side, he continued his work on the distribution of sediment and its effect on corals with results which are not in agreement with current views. This work was completed by an examination of the reef flat to a depth of 15 feet by a hand bore. The samples, which will have to be worked out later, were of unexpected interest, Low Island lying apparently on a foundation of soft mud !

The work of the shore party under the direction of Dr. Stephenson has been concerned primarily with the ecology of Low Island and of Three Isles and the region about Lizard Island. The general ecological survey of Low Island, a general account of the physical features of the island and of the faunas associated with the different regions, has been illustrated and extended by the detailed quantitative survey of narrow strips of ground traversing several different zones and by additional surveys of smaller patches. The arrival of Dr. E. Fraser and Dr. S. M. Manton, who both spent some four months on Low Island, alone rendered possible the completion of this extensive programme of work. Dr. Stephenson also had the assistance of Mrs. Stephenson, while Mr. Spender's surveys of the various regions provided the topographical background.

The other work of the shore party included, as previously noted, an investigation of the breeding seasons of selected corals and other animals by the periodic taking of gonad samples over 10 months, and by other means. Special attention was paid to the production of planulæ by *Pocillopora* and *Porites*, the development of which was studied in great detail. Dr. Fraser also did interesting work on the development of a species of *Eudendrium*. The experiment on the growth rate of corals secured on to cement blocks was successfully completed with striking results in many cases. Further data were secured by the marking of corals *in situ* under water, using the diving helmet. A number of young colonies was collected on clean shells, stones, etc., put out for the purpose. Considerable collections of animals were made during the survey, while Mr. Tandy's botanical collections were supplemented in many ways, notably by the preparation by Miss M. D. Glynne, who stayed with us for three weeks in April, of a map showing the distribution of the *Lithothamnion* zones.

Mr. Moorhouse confined himself very largely to work of economic importance, although he took every opportunity of assisting Mr. Orr and gaining experience in all branches of the work, experience which will be of great value to him in the future when he will be in charge of work, largely economic in character, for the Government of Queensland. He has spent much time observing the habits and life-history of *Trochus*, which he found (contrary to previous reports) to discharge its eggs freely into the sea between the months of March and July, the smallest laying animal having a basal diameter of 5 cm. His work on their growth, from measurements of marked animals and monthly measurements of extensive unsorted collections, points to an increase of some 1·7 cm. in basal diameter in 7 months. He is also able to estimate the basal diameter of *Trochus* one, two, three, and four years old, respectively 2·5-3 cm., 4·5-5 cm., 7-7·5 cm., and 9·5-10 cm. This work represents the first accurate information about the breeding and growth of this economically most valuable animal.

Excellent results were obtained with the sponges cut up and planted out, very considerable growth being recorded. Work was continued on the breeding of bêche-de-mer, while all possible information concerning the fish, either at first hand or from fishermen, was obtained. The work done on Murray Island has been noted above.

The leader's party, consisting of Dr. and Mrs. Yonge and Mr. Nicholls, continued their work on the physiology of corals and certain reef animals. The feeding mechanisms of some forty genera of corals were studied ; all were found quite capable of capturing animal prey, though the actual mechanism involved showed interesting variations. Further work on the digestive enzymes of corals showed that the amylase previously reported comes from the algæ, not the coral, which, however, contains a weak glycogenase. The powerful protease really consists of two enzymes, an ' erepsin ' and a ' trypsin '. Further work was done on the speed of digestion of captured plankton. Waste matter is excreted exclusively by way of the ' absorptive ' zone in the mesenterial filaments. Symbiotic algæ have been found degenerating in many places in the tissues, besides the mesenterial filaments, though never in such numbers as in the ' absorptive ' zone. By heating for an appropriate time at certain temperatures, it is possible to kill many of the algæ without damaging the coral ; this occurred naturally on many parts of the reef flat during the low tides in the summer. The algæ intercept the phosphate excreted by the coral, the phosphate content of the surrounding water dropping quickly to zero, but in the case of corals without algæ (for example, *Dendrophyllia*) the phosphate content quickly rises many hundred per cent.

Further experiments on the oxygen production of the algæ in coral has been carried out, notably experiments with eight corals in jars, samples being taken every three hours over 27- and 12-hour stretches, the results showing that oxygen production only exceeds oxygen consumption during the middle of the day. Similar experiments were conducted at various depths. Owing to the absence of algæ from its tissues, *Dendrophyllia* was frequently used as a control in these experiments. The effect on certain corals of long deprivation of

oxygen was tested. The experiment involving the feeding and starving of corals in light and darkness was continued, and gave results confirming those recorded in previous statements. Corals kept for four months in a light-tight box on the reef flat showed no ill effects other than those caused by the heavy deposition of sediment which smothered some; the survivors were pale, almost all the algæ being dead, but otherwise healthy. Further evidence has done nothing but confirm the view previously expressed that the algæ are useless as food for the coral, but may be of vital importance as the source of an accessory supply of oxygen.

Less detailed work on the algæ in *Tridacna* showed that the algæ here are probably of great importance as food. They form the bulk of the contents of the stomach (here modified in structure) and are found in process of digestion in phagocytes and in the digestive diverticula. There is no evidence that they provide any appreciable amount of oxygen, but they may serve to maintain the hydrogen ion concentration in the mantle cavity. The feeding of *Tridacna*, *Pteroceras*, and *Vermetus* was examined in the light of previous work on the feeding of mollusca.

Mr. Nicholls did special work on the calcium metabolism. He was unable to find any evidence of enzyme agency in the formation of the skeleton in corals. He also did further work on the variation in calcium and excess base in coral pools during low tides by day and by night, and on the calcium content of the fluid in the gut and body cavity of Holothurians. A second spawning period for the pearl oyster (*Pinctada margaratifera*) was found in May, and data as to the rate of growth obtained.

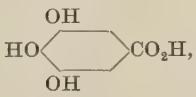
Mr. Spender, who worked for the most part in conjunction with the shore party, completed his detailed survey of Low Island, including soundings outside the anchorage and also at various positions to give characteristic profiles to the reef edge. He also made several level traverses across the flat, along the rampart and over the strips which were being surveyed ecologically. He also surveyed Three Isles, and made general surveys of outer barrier reefs near Lizard Island and around Papuan Pass.

In conclusion, it is particularly gratifying to be able to state that the work of the Expedition, especially on the economic side, will be continued by the Queensland Government, to whom the huts on Low Island and the bulk of the equipment have been given.

The Vegetable Tannins.[1]

By Prof. K. FREUDENBERG, University of Heidelberg.

THE subject of the vegetable tannins [2] is a small field in organic chemistry. Although the subject has been considerably developed and extended in recent years, its beginnings date back to the rise of modern chemistry. One hundred and fifty years ago, Carl Wilhelm Scheele, one of the discoverers of oxygen, in his dark apothecary's shop at Køping in Sweden, allowed an aqueous infusion of Turkish oak galls to be fermented by moulds, doubtless not the first occasion that such a fermentation took place in a pharmaceutical laboratory. But Scheele was one of the best observers chemistry ever had. He noticed that a crystalline substance settled down below the layer of the mould and he was able to recrystallise this substance from water. He called it *sal essentiale gallarum*, and it became known in the literature as gallic acid, having the formula



that is, a trioxybenzoic acid.

In Scheele's opinion, the action of the mould on the extract consisted in the removal of impurities, which might prevent the crystallisation of the *preformed* substance. Some years later, French chemists, however, pointed out that crystalline gallic acid and the amorphous gallotannic acid are not identical. A Flemish botanist, van Tieghem, made a detailed investigation of the fermentation of gallotannin. In the course of his work he discovered a mould specially suited for the fermentation of gallotannin, namely, the well known *Aspergillus Niger*. He was able to show that a mould mycelium, weighing only a few milligrams, was able to decompose some fifty grams of gallotannic acid. He therefore ascribed the action of the mould to an enzyme, named tannase, and further showed that at the same time an alcoholic fermentation sets in, a fact already mentioned by Liebig and attributed to the presence of sugar in the gallotanic acid molecule.

Previously, in 1834, it had been found by Liebig and Pelouze that gallotannin acted upon by dilute acids splits off the same gallic acid obtained earlier by fermentation. In 1850, Strecker published an account of a fundamental investigation on the subject. With hot dilute acid, he obtained in addition to a large amount of gallic acid, a small but definite quantity of glucose.

Unfortunately, at about the same time, theoretical speculations began to obscure clear-cut experimental results. Under the influence of Gerhardt's work on acid anhydrides, Mulder interpreted gallotannin as an anhydride of gallic acid, the sugar content being ascribed to the adventitious presence of an admixed glucoside. Curiously enough, the more analytical methods were improved, the less could Strecker's results concerning glucose be confirmed. His yield of fifteen and more

[1] A lecture given to Section B (Chemistry) of the British Association at Cape Town on July 26, 1929.

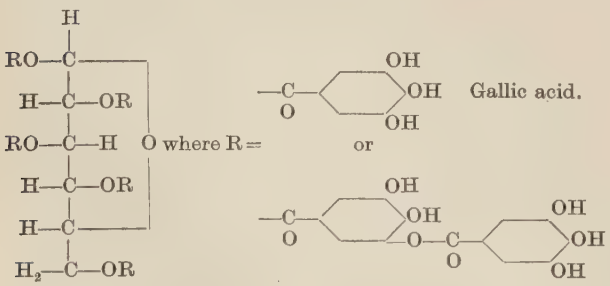
[2] There is some confusion in the nomenclature owing to the fact that 'tannins' (*Gerbstoffe*) in general and 'gallotannin' have been termed simply 'tannins' by Emil Fischer.

per cent was never again obtained ; there seemed to exist samples containing not more than a few per cent of sugar, or even none at all. To-day we know that, presupposing exact laboratory methods, no gallotannin exists yielding less than seven to eight per cent of glucose. I may add that the view that sugar-free gallotannin exists has been abandoned by everyone except Dr. Nierenstein. Some years ago, Dr. Mitchell and, afterwards, Dr. Nierenstein described a gallotannin which was stated to be nearly free from sugar. Through the kindness of Prof. A. G. Perkin, I was able to obtain a sample of their original material. This has been shown by Dr. O. Schmidt (unpublished results) to yield seven per cent of glucose when E. Fischer's method is closely followed. It may be mentioned that Prof. P. Karrer has confirmed E. Fischer's formula quite independently. We know further that the failure to confirm Strecker's work was due to the employment of different specimens of gallotannin.

Strecker's gallotannin originated from Turkish oak galls which do actually contain 15 per cent of glucose, as Strecker has stated. Subsequent investigators were furnished with Chinese gallotannin resulting from galls in the leaves of *Rhus semialata*. This Chinese product, on hydrolysis by dilute acids, does indeed only furnish seven per cent of glucose, as mentioned above.

I have laid some stress on the above results, because they are typical of investigations dealing with amorphous substances. When crystalline material is worked up no discussion about identity or purity need arise.

It is no mere accident that the task of solving the problem fell to Emil Fischer. His experience in handling amorphous proteins and carbohydrates, backed by an exceptional knowledge of analytical and synthetical methods, which he had previously applied to crystalline substances, enabled him to attempt the solution of the problem. At the outset he showed that the glucose does not result from an accidental admixture, but is an essential constituent of the gallotannin molecule. In a manner which was so far as possible quantitative, he studied both the amount of glucose present and the manner in which it is linked to the gallic acid. As a result he proposed the following formula :



Digallic acid.

R is the residue of gallic acid, and five such residues are attached to a glucose molecule which is here represented according to Haworth's amylene oxide formula, which I venture to think has been conclusively established. We thus get a five-fold ester of gallic acid with glucose, the latter playing the part of a pentahydric alcohol. This is the scheme given by Emil Fischer for the Turkish gallotannin studied by Strecker. Joining two molecules of gallic acid we obtain a digallic acid, likewise able to function as *R* ; this is the scheme given for Chinese gallotannin where ten gallic acid residues are accumulated on one glucose molecule by esterification.

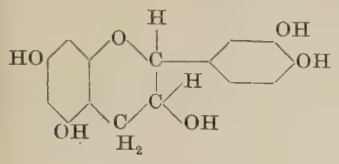
These formulæ are not to be taken as a strict expression of any single chemical individual, but rather as a type. There is no doubt that both varieties of gallotannin, Turkish and Chinese, are a mixture of substances of the same type but differing to a minor extent (P. Karrer). The Turkish gallotannin, composed on the average of five gallic acids and one glucose, may quite well be mixed with similar molecules containing four or six gallic acids. In Chinese gallotannin, the possibility of variations is even greater and it can only be said that the number of gallic acid residues lies between eight and twelve. At the time of Fischer's researches, this kind of structural problem was new, for he only attempted to give a general scheme for the kind of chemical bodies in question. I have already referred to his special fitness for this task due to his experience with amorphous substances.

There is another trait in Fischer's tannin work, characteristic of this master of organic synthesis. We may distinguish two kinds of organic biochemical research. In the first kind, for example, that of indigo or other chemical individual, the goal lies open in front of the investigator like the summit of a mountain. He can measure it and survey it from below and at last venture to attack the summit by undertaking a synthesis. The other kind is that inaugurated by Fischer, my venerated teacher. He explored the large tracts of amorphous substances where marsh land prevents access and primeval forest obscures the view, so that no fixed points are available on which to base a survey. There the master penetrates into the unknown field with a band of his apprentices and obtains a view not only by cutting down some giants of the forest, but also by building up artificial structures from which to survey the surrounding country. Thus the synthesis of a five-fold gallic and digallic ester of glucose was intended to provide an artificial object of comparison for the amorphous substances given to us by Nature.

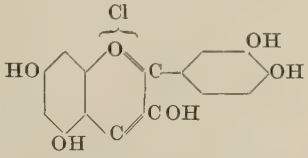
Apart from the gallotannins already dealt with, there exists only one other group of tannins the chemistry of which is based on a sure foundation. The chemistry of catechin and catechol-tannins was outlined only after the gallotannin class had been explored, and in this second group the biochemical relationships are of some interest. The widely distributed amorphous tannins of the catechol group seem to originate by polymerisation and condensation from crystalline primary substances called catechins.

Catechin itself is not uncommon in the leaves

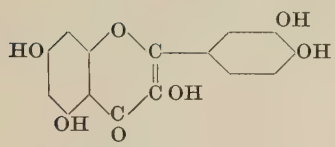
and the wood of various tropical plants. Its constitution, first surmised by A. G. Perkin, shows



Catechin.



Cyanidin hydrochloride.



Quercetin.

a phloroglucinol and a pyrocatechol nucleus, and between them a heterocyclic ring containing an oxygen atom. The connexion between cyanidin and quercetin is evident. Quercetin belongs to the type of yellow colouring matters called flavonols. They are widely distributed throughout the plant kingdom. Cyanidin, in acid solution, is the colouring matter of the red rose and, in an alkaline medium, the blue pigment of the cornflower. On reduction of cyanidin, catechin was ultimately obtained, whereby the constitution of the latter substance was established. I say ultimately, because at first another catechin results, which I called epicatechin. Its presence in plants has likewise been realised. Epicatechin, as well as catechin, contains two asymmetric carbon atoms which cause the existence of two inactive and four optically active forms. They have all been prepared. In passing, it may be observed that the constitution of cyanidin, on which the constitution of catechin and epicatechin depend, has been completely established by synthesis, first by Willstätter and more recently by Robinson. Those botanists who consider that cyanidin and quercetin play a part in the respiratory process of plants should also take catechin into account.

The most widely used of all vegetable tanning materials to-day is the extract of the wood of *Schinopsis*, called *quebracho*, and is produced in South America. Its resemblance to the amorphous tannin produced by condensation of tannin leads to the assumption that there exists likewise a primary substance of the quebracho-tannin which we could name quebracho-catechin. We can even predict its probable constitution. It seems to be distinguished from catechin by the lack of the phenolic hydroxyl group adjacent to the methylene group. Unfortunately, all attempts to isolate this presumed crystalline substance have failed. We know only the amorphous quebracho-tannin, which is recognised as a product of condensation and polymerisation of the hypothetical quebracho-catechin. As catechin is generally accompanied in the plant by the corresponding flavonol, in this case quercetin, so quebracho-tannin contains a flavonol of lower oxygen content, differing from quercetin by the absence of the corresponding hydroxyl group.

Most of the chemical facts we know about the other tannins suggest that these belong to one or other of the two groups described. There exist, indeed, some other types which are evidently quite distinct from these; but their constitution still requires elucidation. So the question is still open whether the tannins of the Cape sumach, *Colpoon compressum*, and of the wattle (*Acacia*) belong to the catechol group or not. The Sicilian tanning material generally called *sumach* is a member of the gallotannin group.

The only resemblance between gallotannin and catecholtannin lies in their high content of phenolic hydroxyl groups. To these they owe their ability to combine with proteins and to convert hide into leather. As a chemical concept the name tannin is without value. In spite of this, however, the group deserves further investigation, on one hand, because its members are widely distributed constituents of plants; on the other hand, because their investigation calls for novel methods which I have endeavoured to indicate.

Obituary.

DR. E. E. SLOSSON.

A WIDE circle of scientific workers and lay readers will learn with regret that Dr. Edwin E. Slosson, director of Science Service, Washington, died at his home there on Oct. 15. He had been suffering from cardiac trouble for some time, and an acute attack about a week previously hastened his end.

Dr. Slosson was born in Albany, Kansas, in 1865, and graduated in the University of Kansas. In 1891 he went to the University of Wyoming to take charge of the department of chemistry, and he also conducted chemical research for the Wyoming agricultural experiment station. He married Dr. May Preston, the first woman who ever received a Ph.D. degree from Cornell University.

In spite of his manifold teaching and research duties, Dr. Slosson found time to work towards his own doctor's degree during the summers, and received it in 1902 from the University of Chicago. He also found time to write numerous little essays on scientific subjects, which, because of their happy style and lucid presentation of ideas in ordinary English, rapidly won him a wide audience. In 1903 he was invited to become literary editor of the *Independent*, a position which he held until 1921, when he was asked to become director of Science Service, then newly organised as an agency for the dissemination of popular knowledge on scientific subjects. He held this latter post until his death.

The most successful of Dr. Slosson's books has

been "Creative Chemistry", which for a decade has held its own among the best sellers. Among his other works are "Easy Lessons in Einstein", "Science Remaking the World", "Keeping Up with Science", "Chats on Science", "Sermons of a Chemist", "Great American Universities", "Plots and Personalities", "The Spirit of American Education", and "Six Major Prophets". He contributed prolifically to magazines, newspapers, and reference works, including the new edition of the "Encyclopædia Britannica". During his eight years as director of Science Service he trained a group of young writers in the ways of popular presentation of science, and these will now carry on his work.

Prof. Heinrich Beckurts.

Dr. Heinrich Beckurts, who resigned the chair of pharmaceutical and food-stuffs chemistry at the Technische Hochschule at Brunswick in 1925, died suddenly on Sept. 15 at Bartgeheide, near Hamburg. From the *Chemiker-Zeitung* we learn that Prof. Beckurts was born at Brunswick in 1855. He graduated at Jena, and in 1877 was appointed an assistant at the Institute of Pharmaceutical Chemistry at Brunswick, where in 1885 he was elected to the newly founded chair, which he retained for forty years. At the same time his former chief, Dr. Robert Otto, who had been professor of general and pharmaceutical chemistry, remained as director of the laboratories. On the retirement of Otto in 1899, Beckurts became director of the pharmaceutical chemical institute, and shortly afterwards the title of Geheimer Medizinalrat was conferred upon him. This title he held until his death.

In spite of the fact that Beckurts remained throughout his career in his native place, he soon achieved a world-wide reputation. It was largely owing to his connexion with the State Department of Health that an institute for the investigation of foodstuffs and of water was founded at Brunswick. The project received at first no financial aid from the State, and it was not until 1900 that his long-cherished wishes were fulfilled. The new institute was designed not only for the training of pharmacists, but also for the official investigation of foodstuffs. During his professorial career, Beckurts devoted himself to the training of students of pharmacy, and the number of candidates who passed the qualifying examination increased very rapidly as the years progressed. His administrative abilities received special recognition on his seventieth birthday, when the title of 'Honorary Senator' of the Technische Hochschule was conferred upon him.

Beckurts found time amongst his multifarious duties for considerable experimental and literary work His numerous researches, which dealt principally with alkaloids, sulphones, nitriles, and propionic acid, were usually published in the *Archiv der Pharmazie*, which he edited in conjunction with E. Schmidt of Marburg, or in the *Apotheker-Zeitung*, which was established at his suggestion. He also published a work on analytical chemistry for pharmaceutical chemists, and for many years he issued the *Jahresbericht für Pharmazie, Pharmakognosie und Toxicologie*. In collaboration with Dr. B. Hirsch he published a "Handbuch der praktischen Pharmazie", and with Dr. O. Lüning he remodelled Mohr's well-known treatise on volumetric analysis.

News and Views.

The celebration, not only in the United States, but also in Amsterdam, Rome, and other places, of the fiftieth anniversary of the production by Mr. Thomas A. Edison of his first incandescent electric lamp was a remarkable tribute to the great inventor, now in his eighty-third year. The principal gathering took place at Greenfield, the village constructed by Mr. Henry Ford on his estate at Dearborn, Michigan, to which has been transported the laboratory in which Mr. Edison worked so long at Menlo Park, New Jersey. In the re-erected laboratory, in the presence of President Hoover and many distinguished guests, on Oct. 21, Mr. Edison repeated his historical experiments which resulted in the completion of his first successful lamp. During the celebrations, an account of which was broadcast, Mr. Hoover voiced the nation's appreciation of "men who have that originality of mind and that devotion to industry to carry scientific thought forward in steps and strides until it spreads comfort in every home". The village of Greenfield is to be a part of a great museum of Americana, an object lesson in American progress, which Mr. Ford is inaugurating in connexion with the Edison Institute of Technology.

It is a pity that the celebrations in honour of Mr. Edison and 'Light's Golden Jubilee' should have been marred by the extravagant claims made for him in connexion with the incandescent electric lamp. In the *Scientific American* for November, Mr. Ford is reported to have said that Edison "by his invention of the incandescent light contributed more to the progress of the world and the comfort of his fellow beings than any other man". The world acclaims Edison as one of the greatest of inventors, but it is not true to say that it recognises him as the founder of the electric lighting industry. It will be remembered that the Institution of Electrical Engineers in Great Britain commemorated the fiftieth anniversary of the invention of the incandescent lamp by Sir Joseph Swan on Dec. 20 of last year. A résumé of the historical facts on which the claim is founded is given by K. R. Swan in the *Electrician* for Oct. 25. In a recent biography of Edison by G. S. Bryan, Edison is credited with the invention of the 'squirted' filament which gave such stimulus to the more general use of incandescent lighting in the early days. This vital improvement in the manufacture of carbon filaments was due, however, to Swan, who invented it so far back as 1883. It seems a pity that history should be so garbled. In Great Britain the practical manufacture of the incandescent carbon filament lamp owes little to Edison; it was based entirely on Swan's work. Moreover, Mr. A. A.

Campbell Swinton has pointed out on several occasions that the first patentee of the method of 'flashing' used in making carbon lamps was Mr. Lane Fox Pitt.

AT a meeting of the Council of Management of the British Science Guild, held on Oct. 17, the following resolution was passed relating to the constitution of the Royal Commission on the Civil Service recently appointed: "That having in view the circumstance that the State directly conducts, under its own management, important and highly scientific and technical undertakings, such as the telegraph and telephone services, and also recognising that science has to-day a very important bearing upon so many of the problems dealt with in and by Government Departments, the Council is greatly disappointed to find that the Royal Commission on the Civil Service recently set up by His Majesty's Government does not include among the members a single man of science or one engaged in the application of science to the needs of the community. The Council records its emphatic protest at the omission to appoint upon the Royal Commission a due proportion of members familiar with national aspects of pure and applied science, particularly in view of the fact that an urgent necessity exists at the present time for a complete and impartial review of the status and functions of the considerable body of scientific and technical experts forming part of the Civil Service." The Council also adopted a resolution urging the Government to appoint a Royal Commission on the Post Office with the view of considering the separation of the telegraph and telephone department on one hand from that of the mails on the other, in order to secure the efficient development of the electrical communication services.

THE problem of increasing size in heavier-than-air flying machines is largely one of a conflict between two contending factors. The structural weight increases roughly as the cube of the dimensions, while the lifting capacity, depending as it does on the wing area, increases only as the square. Advance, therefore, in this direction depends largely on the low aerodynamic resistance qualities of the exposed parts and on progress in design of the power unit. The flight over Lake Constance on Oct. 21 of the 12 engine flying-ship *Do. X* appears to mark a distinct advance on previous work of this description. With 169 persons on board, including 10 of the crew, the ship rose from the water in about 50 seconds, carrying fuel for a flight of 750 miles, and landed after a trial run lasting nearly an hour. The machine is said to have weighed almost 52 tons, but it was not fully furnished. This preliminary test stamps Herr Dornier's ambitious effort as a complete success, and this monster flying boat as, broadly speaking, a practical machine.

FROM the few figures available it appears that, when fully equipped for a 500 mile flight, the *Do. X* has a disposable load of 16 tons at a cruising speed of 100 m.p.h. Herr Dornier's achievement really consists of the fact that he has succeeded in building a very large flying boat in which the proportion of structure weight to total weight is about what is considered ordinarily feasible in other machines. There are, however, certain consequent disadvantages. An alighting speed of 90 miles an hour as against 60 miles an hour for most British boats is very high, implying as this does almost a full minute of running before rising; and coupled with a heavy h.p. loading of 18-19 lb., it would indicate that there is little reserve for adverse water conditions. Thus, when fully loaded, she would require to operate from relatively sheltered waters under prepared conditions. There is little reason to doubt that if the greater margin of safety insisted upon in Great Britain were to be sacrificed, corresponding advances could equally be achieved.

THE president of the North-East Coast Institution of Engineers and Shipbuilders this year is Mr. L. E. Smith, chairman and managing director of Smith's Dock Co., South Shields, a business which was established in 1768, and is mainly concerned with ship-repairing. Mr. Smith's presidential address on Oct. 25 was therefore devoted to ship-repairing, which is as old as shipbuilding itself. The earliest slipway for ships was probably that near Phalerum, in Greece, constructed about the fifth century B.C.; the first English dry dock was that built at Portsmouth in 1494, by order of Henry VIII. Early dry docks were closed by embankments of piles and clay, and it took weeks to 'undock' a ship. Reminding his audience of the important work done by ship-repairers during the War, Mr. Smith referred to the great changes taking place and the growth in the size of ships. Though there are plenty of building berths, he thinks that there will soon be a great shortage of docks.

OF recent developments in shipping, the oil tankers and motor-ships are most notable. From Lloyd's Register Book it appears that in 1909 the gross tonnage of oil tankers was 789,000; in 1929 it was 7,071,000. Also, during the last ten years, the tonnage of ships built and fitted with steam reciprocating engines has fallen from 2,633,000 to 853,000, the tonnage of ships with steam turbines from 1,051,000 to 209,018. The total tonnage of motor ships in 1909 was negligible; in 1919 it was 752,000, and in 1929, 6,628,000. Though great problems confront the shipbuilding world, it is, Mr. Smith said, "the admitted fact that Great Britain has at last regained the commanding position she always held before the War both in the shipbuilding and ship-repairing world, and she has been able to do so almost entirely owing to her highly efficient organisation and very low cost of production".

THE October issue of the *Journal of Philosophical Studies* contains the report of a lecture entitled "Beyond Physics" delivered by Sir Oliver Lodge on July 26 at the fourth ordinary general meeting of the British Institute of Philosophical Studies. After an appreciative criticism of Prof. Eddington's Gifford Lectures, there follows a philosophically important attempt to find a permanent physical basis for life and mind. While admitting the impossibility of the transmission of anything substantial or energetic with a velocity faster than that of light, Sir Oliver Lodge is not prepared to grant that velocity through the ether is meaningless, and he even suggests that such a velocity may hereafter be observed by using as a frame of reference the rare cloud of interstellar matter

which recent advances have detected. The ether or space is regarded as stationary in respect of locomotion and as the seat of tremendous rotational energy. At places where group waves are formed, we get material particles and locomotion.

SIR OLIVER pointed out that waves can exist which travel faster than light, but they are mere forms which convey no energy and are therefore unable to affect instruments. The energy is all associated with the groups, which subserve the functions of matter. Experimentally, then, we can deal only with the groups. But what of the component waves which give rise to the groups, which interact with them, which are in fact the very condition for the group's existence? They have no energy of their own, but they achieve results which would not otherwise be achieved. Now life is just such a guiding and directing principle, and the bold hypothesis is advanced that these constituent waves of excessively high frequency may be the physical basis, though not in the least a material basis, for an idealistic interpretation of the universe in which life and mind are supreme. How spontaneity and free will can be given a physical basis Sir Oliver Lodge does not fully see, but he maintains that it is not in a postulated defect in the law of causality for small particles, for chance is no way to aim at freedom nor do the laws of probability apply to the individual. The point of view here briefly summarised is so novel and has such implications that it is worthy of careful consideration even should it prove to be untenable.

SIR THOMAS PURVES, the Engineer-in-Chief of the British Post Office, delivered his inaugural address on electrical communications as president of the Institution of Electrical Engineers on Oct. 24. The audience included not only a large gathering at the Institution's headquarters on the Victoria Embankment, London, but also similar gatherings at the local centres of the Institution at Manchester, Liverpool, Birmingham, Glasgow, Leeds, Newcastle, Cardiff, Southampton, and Portsmouth. Transmitters and loud speakers were fitted at each place, so that speech from any point was reproduced at all other points. The occasion furnished a demonstration of an interesting innovation in the British trunk telephone service known as 'Conference Communication'. This facility, which is now available to the public, enables conferences and discussions to be carried on by joint participants assembled at several different places. In the course of the proceedings, speakers at all the centres took part, and their speeches were clearly heard at all the other centres.

IN his presidential address, Sir Thomas Purves gave a very interesting résumé of the tremendous advances that have been made in systems of electrical communication during the last few years. Seven years ago it was only possible for the British telephone user to communicate with Paris and Brussels. To-day anyone can speak from any telephone in Great Britain to nearly ninety per cent of the telephone stations of the world. In seven years' time the number of automatic exchanges in the central London business area will have increased from its present value of 21 to 100. This rapid increase has to be made without interrupting the continuous service which every subscriber expects. Luckily, the difficulties and mishaps that have arisen during the last few years are much fewer than had been anticipated. England was practically the only country in the world which had an appreciable number of trunk telephone circuits before the advent of the telephone valve repeater. These circuits had a limit of about 200 miles, and the weight of copper used in them was about 300 lb. per mile. The harnessing of the electron has made possible the use of light gauge cables containing about 30 lb. of copper per mile, and these cables will work through valve repeaters to at least 14,000 miles. The Post Office station at Rugby can telegraph to any properly equipped ship in any of the oceans of the world. The trans-Atlantic radio circuits connecting London and New York enable the millions of telephone users in America and Europe to communicate with one another. The stability of the service across the Atlantic depends mainly on the 'long wave' service, but there are two, and there will soon be three, short wave services in addition. The combination of these services ensures practically a 100 per cent continuity of service. They also enable sudden heavy demands to be met. Language difficulties between America and continental nations are the main source of trouble.

AT a meeting of the Newcomen Society held on Oct. 23, a paper by Mr. L. F. Loree of New York was read dealing with "The First Steam Engine in America". Copper ore had been discovered on land belonging to Arent Schuyler of New Jersey about 1714, and for thirty or forty years mining was carried on vigorously, the ore being sent to England to the Bristol Copper and Brass Works. Smelting and refining were not permitted in the colonies, and the export of machinery from England to the colonies was forbidden. By 1748 the mine shaft had been sunk so far that water gave very serious trouble. News having reached America about the Newcomen steam engine or 'fire engine', Colonel John Schuyler, through his agent, ordered an engine from the Hornblowers of Cornwall and, accompanied by Josiah Hornblower (1729–1809), this engine, the very first erected in America, was taken across the Atlantic in the *Irene*. It was shipped in June 1753, but it was not until March 1755 that the engine-house had been built and the engine erected ready for use. Of its subsequent history, its partial destruction by fire, its repair twenty-five years later, and of the acquisition by the Smithsonian Institution of one-half of what is supposed to be the original cylinder, Mr. Loree gave an interesting account. He described Hornblower, who became an American citizen, as a man of simple tastes, courtly bearing, and commanding presence, and said that he served as a member of the Legislature and occupied other public offices. Buried in the grounds of the Belleville Reformed Church, his tomb has recently been restored by the American members of the Newcomen Society, who have also erected a memorial to this "pioneer in the use of steam in the western hemisphere and a foremost promoter of our American industrial civilisation".

THE small-pox which is now somewhat prevalent in Great Britain (131 cases were notified in England and Wales in the week ended Oct. 12), being of a mild type, is apt in early cases to bear so close a resemblance to chicken-pox that diagnosis becomes exceedingly difficult. A 'flocculation test', first devised by M. H. Gordon, and suggested by him as a means of differentiating the two diseases, is the subject of a report by W. L. Burgess, J. Craigie, and W. J. Tulloch (Med. Res. Council; *Special Rep. Series*, No. 143. London: H.M. Stationery Office. 1*s*. 3*d*. net). A 'vaccinia serum' is prepared by treating rabbits with vaccine material, and this serum mixed with an extract of the crusts from the patient gives flocculation when the crusts are derived from a small-pox case, but not if derived from chicken-pox or other diseases. Cases of small-pox (53 cases), chicken-pox, vaccinia, and other conditions occurring in Dundee and elsewhere, were examined by the authors, 93 cases in all, and in every instance in which the test could be carried out satisfactorily, the results obtained by it were in complete agreement with clinical findings and epidemiological inquiry.

IT is significant of the activity in anthropological studies of the Bernice P. Bishop Museum of Honolulu, that the valuable series of monographs which are appearing as *Bulletins* of the Museum are now being issued at frequent intervals and cover an increasing range in the Pacific area. Among recent issues are an extended study of Tongan society by Mr. Edward Winslow Gifford, one of the Bayard Dominick Expedition series in which a number of monographs by different members of the Expedition have already appeared, a valuable study of the archæology of Tonga by W. C. McKern in the same series, and a study of Lau Island, Fiji, by Mr. A. M. Hocart, the outcome of a stay of four years in Fiji, which bears witness to the industry and powers of observation of the author. Mr. Hocart is not the only British author represented in the series.

BULLETIN 63 of the Museum at Honolulu is by Prof. F. Wood Jones and is entitled "Measurements and Landmarks in Physical Anthropology". The reason for its inclusion in the series is not obvious, and indeed its value to the anthropologist at large is such that it may perhaps be regretted that it should have been published in a form in which it may escape the notice of many to whom it would be of value. It is intended as a guide for both the laboratory and the field worker. Prof. Wood Jones in fact has selected a series of the twenty measurements for the use of the field worker which he considers most significant, having in view also the conditions under which the measurements will be taken. The author has described the measurements of the living and the skeleton in great detail, and each part is dealt with at some length. In view of the consideration now being given to the character and method of anthropometric measurement and the suggestions recently submitted to the Royal Anthropological Institute by Miss M. L. Tildesley and transmitted by that body for the consideration of the Committee on Anthropometric Measurements of the Congress of Anthropology of the Institut International de Paris, we hope that Prof. Wood Jones' work will not be overlooked by the physical anthropologists in England and on the Continent.

MR. J. J. JOICEY has presented to the Department of Entomology of the British Museum (Natural History) the whole of his collection of butterflies from South and Central America belonging to the subfamily Theclinæ, amounting to between five and six thousand specimens and including eighty-eight types. Many of the latter represent species of very considerable rarity. The butterflies of this subfamily, of which the few British representatives are known as hairstreaks, are mostly small in size, but are noted for the extraordinary brilliance of their colouring. The Department of Geology of the Museum has acquired the Buckman collection of fossil Brachiopoda and ammonites. This numbers about 25,000 specimens, mostly brachiopods, and nearly all from the English Jurassic rocks. It is the bulk of the material collected by the late Prof. James Buckman and his son, the late Sidney Savory Buckman. The former had unique opportunities for collecting, since he lived in the south-west of England when the early railways were being made, and this involved not only the opening of the railway-cuttings, but also the quarrying of local stone for bridges, etc. His son studied and collected from the English Jurassic strata all his life and acquired a specialist's knowledge of brachiopods and ammonites. He did not stop at mere classification, but developed interesting theoretical considerations both in palæontology and stratigraphy. Another important recent purchase for the same Department is a large portion of the skeleton of a rhinoceros, *Diceratherium cooki*, from the locality in Nebraska which yielded the skeleton of *Moropus*, purchased lately. The specimen represents an adult animal, rather larger than a Shetland pony. The diceratheres are distinguished from all other rhinoceroses by having the paired nasal horns placed side by side, instead of tandem. They arose in North America and migrated to Europe: bones and teeth have been found in France.

THE provision of national parks has made great progress in Canada. Apart from the enormous Wood-Buffalo Park in the Peace River district, there are more than thirty thousand square miles of national and provincial parks in which no land is for sale and no concessions are allowed. Great care is taken of the wild life, and hunting and trapping are prohibited. Roads and trails are made for visitors, but the natural scenic features are not interfered with. Sites for residential purposes are leased but not sold. The National Parks Service of the Canadian Department of the Interior has published a number of hand-books on several of the parks in the Rockies and Selkirks. The books are well supplied with photographs and maps and give an excellent idea of the value these parks must have as centres of recreation and sanctuaries of wild life.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, Oct. 28, the following officers were elected: *President*: Prof. Sir E. A. Sharpey-Schafer; *Vice-Presidents*: Em. Prof. W. C. M'Intosh; Prof. Sir Robert W. Philip, Prof.

J. Graham Kerr, Prof. W. Wright Smith, Prof. Francis G. Baily, Prof. T. J. Jehu ; *General Secretary* : Prof. R. A. Sampson ; *Secretaries to Ordinary Meetings* : Prof. C. G. Darwin and Dr. James Ritchie ; *Treasurer* : Dr. James Watt ; *Curator of Library and Museum* : Prof. D'Arcy W. Thompson ; *Councillors* : Prof. J. H. Ashworth, Prof. E. Taylor Jones, Dr. J. B. Clark, Prof. F. A. E. Crew, Prof. J. Montagu F. Drummond, Mr. D. A. Stevenson, Prof. H. W. Turnbull, Em. Prof. Sir James Walker, Dr. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houstoun, The Hon. Lord Sands.

THE auction sale to be held by Messrs. Sotheby and Co., at 34/35 New Bond Street, W.1, on Nov. 4–7, should be of special interest to many readers of NATURE, seeing that on the first two dates will be offered many important works formerly the property of Sir E. Ray Lankester and Sir William Thiselton-Dyer. The Lankester collection is particularly rich in first editions—among which we notice Darwin's "The Origin of Species" and "The Descent of Man", Galton's "Natural Inheritance", and thirty-four volumes by H. G. Wells, many autographed. The Thiselton-Dyer collection includes a complete set of the *Kew Bulletin*, long runs of "Flora Capensis" and "Flora of Tropical Africa", and the first edition (black letter) of Lyte's translation of Dodoens' "A Nievve Herball".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A headmaster of the Wandsworth Junior Technical (Day) School—The Secretary, Technical Institute, Wandsworth, S.W.18. (Nov. 9). An assistant lecturer in engineering at the Bath Municipal Technical College—The Director of Education, Education Office, Sawclose, Bath (Nov. 9). An assistant pathologist at the Mount Vernon Hospital, Northwood—The Secretary, Mount Vernon Hospital, 7 Fitzroy-square, W.1 (Nov. 9). A director of Public Health and Medical Services under the Government of Southern Rhodesia—The Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2 (Nov. 15). A pathologist to the Royal Hospital and demonstrator of pathology in the University of Sheffield—The Registrar, The University, Sheffield (Nov. 16). A lecturer in pathology in the University of Sheffield—The Registrar, The University, Sheffield (Nov. 16). A public analyst of the Harcourt Butler Institute of Public Health, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Nov. 23). An assistant lecturer and demonstrator in geography in the University of Leeds—The Registrar, The University, Leeds (Nov. 25). A Geoffrey Duveen travelling student in oto-rhino-laryngology in the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A full-time lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A laboratory assistant for the Medical Department of the Government of the Uganda Protectorate—M/1720, The Crown Agents for the Colonies, 4 Millbank, S.W.1.

Our Astronomical Column.

Mars.—*La Science Moderne* for September contains an article on Mars by A. Nodon, president of the Astronomical Society of Bordeaux. He reproduces several drawings made by E. M. Antoniadi at Meudon and J. Comas Sola at Barcelona. A description of the temperature measures of Menzel, Coblentz, and Lampland leads to the conclusion that the conditions are likely to be suitable for the presence of vegetation, and that the various tints observed in the darker regions of the disc are compatible with this view of their nature. Some of the drawings show numbers of small round dark markings, the positions of which appear to change between one opposition and the next. It is noted that snow or frost on the ground can be distinguished from cloud or mist in the air by the greater permanence in the position of the former. There are some speculations about the future of the earth ; it is suggested that in the distant future the ocean may have largely disappeared, and the height of the mountains have been greatly diminished by denudation, which would bring about a resemblance to the present condition of Mars.

Greenwich Observations, 1927.—There are two novel features in this annual volume. First, the time service has been derived from observations made with a small reversible transit instrument instead of using the transit circle as heretofore ; the time derived from the transit circle appears to be that of a meridian about 0·10 sec. to the east of it. The cause of this is supposed to lie in the determination of collimation ; the aperture in the central tube of the instrument, through which the south collimator is viewed from the north one, is crossed by radial bars, which seem to have some effect on the character of the image. The collimation errors adopted for the last half of 1927 varied from 1·44″ to 1·05″ ; it is found that if 1·65″ had been used throughout, the results would have agreed with those of the small transit.

Another change is in the method of reducing the moon observations ; Brown's longitude of the moon is in error by some 6″ in the mean ; owing to the eccentricity of the orbit, this causes varying errors in the individual observations. An estimated value of the mean error of longitude for the year is formed, and the time for the moon to go through this arc is multiplied by the rates of motion in R.A. and declination at each observation. Improved tabular places are thus formed for comparison with the observations. When the mean error of longitude for the year is formed from these, the constant that was removed must be put back. Another special feature of this volume is a comparison of magnetic storms and sunspots from 1874 to 1927. The great magnetic storms are on the average accompanied by large spots not far from the centre of the disc. There is a semi-annual wave in the frequency of magnetic storms ; the maxima are near March and September, the months when the earth is farthest from the sun's equator.

Occultation of Jupiter by the Moon on Oct. 28, 1928.—This phenomenon was well observed at Johannesburg with the 26½ inch refractor and two smaller instruments (*Union Obs. Circ.*, No. 79). Satellite III. took 3·5 sec. to disappear, II. 1·5 sec., I. 2·0 sec. I. appeared to have the greatest surface brightness. Jupiter appeared very dim beside the moon ; it was described as "a grey ghostly disc" with indefinite limbs.

Research Items.

Unknown Tribes in Arabia.—An account of a journey undertaken in 1928 in a part of S.E. Arabia previously untrodden by Europeans, is given by Mr. Bertram Thomas in the *Journal of the Royal Anthropological Institute*, vol. 59, part 1. The journey of 650 miles from Suwaih to Dhufar occupied 48 days. From Wadi Sarab (lat. 20.10 : long. 57.45 E.) to Salala, capital of Dhufar (lat. 17.20 : long. 54.6 E.) is the habitat of a group of five tribes which are racially distinct from the Semitic Arabs, speaking four dialects not understood by Arabs, and having closer affinities with Ethiopia than Arabia. There are Harasīs, Bautāhara, Mahra, Qara, and Shahara. They are clearly a block of non-Arab tribes of great local antiquity, and as regards the last four, at least, of Hamitic origin. They have an ancient tradition of a North African origin. They have many interesting and perhaps unique customs. The women are not veiled and tattoo the chin with a short vertical line with a dot on each side. Some have a bracelet-like design round the wrist. In Dhufar they paint the face red, black, and green for religious festivals, marriages, circumcisions, etc.—generally a line along the edge of the cheek under the cheekbone and one bridging the nose across the eyebrows. The men are not tattooed. The women shave a half-inch parting along the centre of the top of the head and around the forehead to show a large expanse of brow. The boys' hair is cut short except for an inch wide strip. The men shave clean except for the chin tuft by which they swear. Circumcision is universal, the boys at adolescence, the girls on the day of birth or the second day, the reverse of the custom in Oman, where the ages are 6 for boys and 10 years for girls. In Dhufar elaborate rites are performed in which, after the operation, the boy, carrying a sword, is chased three times round the assembly by an unveiled virgin, also holding a sword. A wife must not show grief at the death of her husband. With the Qara death is a time of wholesale sacrifice of cattle, camels, and sheep. Special reverence is shown for the cow, especially at milking, which is a male prerogative. It is shameful for a woman to touch the udders. This reverence for the cow is completely reversed in Oman, where milking is only fit for women, and the cow is almost an unclean animal. The Harasīs will neither milk nor slaughter their sheep in sunlight, and two breeds of sheep no tribesman whatsoever will slaughter until after dark.

Variations in the Composition of Milk.—It is well known that the composition of milk is somewhat variable, and a committee of the Ministry of Agriculture and Board of Agriculture for Scotland has issued a summary of the circumstances known to be associated with such variations (Min. Agric. and Fish., *Miscellaneous Publications*, No. 65, London : H.M. Stationery Office, price 4*d*.). The mean percentages of fat and of solids-not-fat have been found to be respectively 3·70-3·95 and 8·746-8·78 (Tocher, Crowther, Cranfield). The fat content is likely to be low when a long interval elapses since the previous milking, and when the milker is inexperienced and fails to draw the 'strippings'. As the cow ages, the average percentage of fat falls, and during lactation there is a gradual fall until the 14-16th week, followed by a gradual increase. Different breeds yield different fat contents, the Jersey being richest (5 per cent or more) and the British Friesian lowest (3·7 per cent). Underfeeding, while reducing the *yield*, affects the *quality* of the milk only slightly. Day-to-day variations in composition occur and are difficult to explain. From figures derived from two dairy companies, 7-8 per cent of churn samples are likely to be deficient in fat, and 5 per cent in non-fatty solids. Cranfield and Ling have recorded the composition of the milk of an abnormal cow during three lactations. Fat percentages were very variable, but solids-not-fat were consistently low, only 2 per cent of the samples exceeding 8·5 per cent. During the first two lactations no abnormality of the animal could be detected, but during the third tuberculosis of the udder and lungs developed, and it is suggested that an abnormally low solids-not-fat content may be a sign of incipient disease (*Jour. Agric. Sci.*, vol. 19, p. 491).

Birds of North-Eastern Brazil.—The bird fauna of north-eastern Brazil is rich in species, for a comprehensive list, based upon collections made by Heinrich E. Snethlage between 1923 and 1926, but including every species recorded in literature from the three States concerned, comprises 524 forms (Charles E. Hellmayr in *Field Mus. Nat. Hist. Zool. Series*, vol. 12, No. 18, 1929). Within the boundaries of the region discussed, little differentiation seems to have taken place, and, contrary to the conditions in the Amazonian region, the rivers in this part of Brazil have little zoogeographical significance. But it is clear that the bird fauna contains several distinct elements. A group of forest birds of Amazonian parentage appears to have penetrated eastward by following the gallery forest which extends along the banks of many rivers far into the open country. Many of these are unknown in eastern Brazil. Beyond the forested belt, in a southerly direction, occurs a second, very different fauna, which presents a great resemblance to the bird life of Bahia. Other elements are less evidently associated with the neighbouring geographical areas, some having been found so far in a restricted portion of the area investigated, while others find a limit set by the Rio São Francisco, east and south of which they are either absent or are represented by allied forms.

Histology of the Mid-Gut of *Vanessa*.—H. Henson has examined the histology of the mid-gut in the five larval stages of *Vanessa urticæ* (*Quart. Jour. Micr. Sci.*, vol. 73, part 1, 1929). The mid-gut has three categories of cells—interstitial, goblet, and columnar. The interstitial cells renovate the epithelium by the addition of new cells at each larval ecdysis. There is a period at the beginning of each instar during which occurs cell differentiation from interstitial nests, but this process soon ceases. Cell division, by mitosis, of the interstitial cells occurs throughout the instar. The goblet cell cannot become a columnar cell, neither can the former be derived from a senescent columnar cell, for goblet cells are present at the time of hatching. Both are derived by independent modification of interstitial cells. The contents of the goblet have the same affinity for counter-stain as the striated border and appear to consist of a closely packed mass of fibrils not optically distinguishable from the striated border. The author favours the view that the secretion vesicles seen on the ends of many of the columnar cells are not the result of a secretion process but of a process of cell disintegration due to wear and tear or to the incidence of metamorphosis.

Internal Secretion in Invertebrates.—G. Koller (*Biological Reviews*, vol. 4, No. 3, 1929) reviews our present knowledge of internal secretion in invertebrates. The presence of active sexual hormones can be assumed with reasonable certainty in cases where

parasitic or experimental castration brings about specific changes in secondary sexual characters, for example, the parasitic castration of *Carcinus*, *Inachus*, and *Pagurus* by Rhizocephala, the result of which in male crabs is a definite approach to the female facies. It has been shown by the castration, by radium, of *Asellus aquaticus* that the development of the brood pouch in this animal is dependent upon the presence of functional ovaries, but experiments on caterpillars by several investigators do not permit the assumption that sex hormones exist in these animals. In the Sipunculid *Physcosoma*, Harms has demonstrated histologically and physiologically the existence of an endocrine gland (internephridial organ) the secretion of which is essential to the life of the animal. The characters of the branchial and pericardial glands of Cephalopods suggest endocrine action. The œnocytes of larval and adult insects are unicellular endocrine glands. Koller has shown by blood transfusion that internal secretions are probably concerned in the ecdysis and pupation of caterpillars, but the site of formation of the hormones is unknown. Koller and Perkins have shown experimentally that the expansion and contraction of the chromatophores of shrimps and prawns is due to substances secreted into the blood in response to light stimuli. The two secretions concerned are formed respectively in the eyes and in the rostral region.

Pug-headed Trout.—The occurrence of the abnormality known as pug-head or bulldog-head amongst fishes has often been recorded, and E. W. Gudger has summarised the cases found in Salmonoids, and describes new examples which have come to his notice (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, Sept. 1929, p. 531). The deformity would appear to be due to a failure of the base of the skull to elongate, the check to the growth of the parasphenoid tying down the surrounding bones, so that the upper part of the head remains in an essentially embryonic condition, while the lower jaw attains almost normal size. Feeding is not prevented by either of the two forms which the deformity assumes amongst salmonoids, but there is a suggestion, founded on a limited number of breeding observations, that the malformation is inheritable and transmissible. The author makes a geographical error which we cannot pass: "Next for England", he says, and proceeds to discuss more Scottish examples. Indeed, in a wonderfully complete catalogue, he omits one of the few examples which England has supplied, that of the bulldog-headed trout from a beck on Pennyghent, described by Clarke and Roebuck in "The Vertebrate Fauna of Yorkshire".

Origin of Cultivated Wheats.—Further attempts are being made to throw light on the origin of cultivated wheats by a study of the chromosomes. The hexaploid wheats might be autopolyploid, with six similar sets of chromosomes, or allopolyploid with unlike sets derived through crossing of different species. Mr. Fuyuwo Kagawa (*Jour. Coll. Agric. Tokyo*, vol. 10, No. 3) has made measurements of the chromosome sets in various species of *Triticum* and *Ægilops* in order to obtain evidence on this point. The chromosome sets of *T. monococcum*, *T. dicoccum*, *T. polonicum*, and *T. vulgare*, *Ægilops speltoides* ($2n = 14$) and *Æ. cylindrica* ($2n = 28$) were compared as regards the length and the number and position of constrictions in the chromosomes. In *T. polonicum*, for example, the 28 chromosomes are of at least eight types, differing in length and the position of constrictions. Six of these types do not correspond to chromosomes in the set of *T. monococcum*. The 28 chromosomes of *T. dicoccum* are classified into ten types, seven of which are different from those of *T. monococcum*. The 42 chromosomes of *T. vulgare* belong to at least nine types, eight of which appear to differ from those of *T. monococcum*. It is concluded that the polyploid wheats possess only one pair of most of the chromosome types and that they did not originate through duplication of a basic set, but probably from crossing among ancestors having different sets. Similarly it is concluded that the tetraploid *Ægilops cylindrica* did not arise through duplication of the chromosome set of a diploid species such as *Æ. speltoides*.

The Great Barrier Reef.—The nature and origin of the Great Barrier Reef and the Queensland coast are discussed in great detail in a paper by Mr. J. A. Steers in the *Geographical Journal* for September and October. Previous writers on the origin of the reef fall into two classes, those who regard the reef as a thin veneer on a platform, and those who see in it evidence of the submergence that Darwin suggested. Mr. Steers, who was attached to the Great Barrier Reef Expedition, believes that faulting or flexing of the peneplain of north-eastern Australia has been more important in the formation of the reef than the subsidence of the continent. Evidence of faulting was found in practically all parts of the reef region visited. Similar evidence is known from other parts. Faulting has obviously played an important part in the formation of the coast-line. Mr. Steers goes on to show that the trend lines of the continental shelf are similar to those of the mainland, and he concludes that the Barrier has grown up concurrently with the subsidence of a series of fault blocks. At the same time he shows that faulting has been most intense in northern and north-central parts of the Barrier area. It is of interest also to note that borings on the Michaelmas cay show that a coral reef can grow up on unconsolidated material.

Miocene Mollusca from Jamaica.—The first part of an important work by W. P. Woodring on the Miocene mollusca from Bowden, Jamaica, appeared in 1925 and was noticed in these pages at the time (NATURE, Dec. 12, 1925, p. 881). We have now the pleasure to record the publication of Part 2 dealing with the gastropods and giving a discussion of the results (Carnegie Inst., Washington, *Pubn.* No. 385). This ponderous volume of 564 pages and 40 plates in every respect resembles its predecessor in the scrupulous care with which it has been compiled and produced and it fully merits similar praise. It seems that the total number of molluscan species present is 610, all marine, for though some land snails have been recorded, the author considers them to have been accidental introductions of living animals that fell into openings in the ground and so got collected with the fossil material. No other American Tertiary locality has yielded so abundant a molluscan fauna. The origin, ecology, and age of the Bowden fauna are fully discussed. The author summarises the published information on the Miocene mollusca from other localities in the American tropical region to which naturally they are most akin, whilst directing attention to their similarity to those of southern France and the Mediterranean region. The Bowden horizon would appear to fall at the top of the Middle or at the base of the Upper Miocene.

Italian Earthquake of Mar. 27, 1928.—Two useful studies of this earthquake in the Carnic Alps have been published, one by Prof. A. Cavasino (*Ital. Soc. Sism. Boll.*, vol. 28, pp. 77-100; 1929), the other by Prof. M. Gortani (*L' Universo*, Dec. 1928). Though the intensity was high (9 or 10, Mercalli scale), the epicentral area contained only 30 square miles, its centre

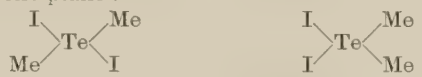
being in lat. 46° 21′ N., long. 12° 59′ E. The intensity decreased rapidly outwards, implying a small depth of focus, 4 or 5 miles according to Gortani, and 11 miles according to Cavasino (using Seebach's method). The epicentral area was elongated north and south, transversely to the tectonic lines of the Carnic Alps. Cavasino, from a large number of observations, estimates the mean velocity of the primary waves as 7·3 km. per sec. and of the secondary waves as 4·0 km. per sec.

Variations of Mean Sea-level.—It is often supposed that once the variations of sea-level due to astronomical (tidal) and meteorological causes have been eliminated, carefully made tidal observations afford a secure basis for establishing the datum plane required in geodetic levelling, and for detecting possible changes in the level of the land. In "Studies of Mean Sea-level" (*Bull. Nat. Res. Council*, No. 70, Washington, 1929), Douglas Johnson, in a report written for a Committee appointed by the Council to make shore-line investigations of sea-level, indicates various causes why this supposition is untrustworthy. Chief stress is laid on variations of level due to changes in inlets and bars at the mouth of estuaries or nearly enclosed bays into which rivers flow; the changes in tidal currents due to such and other causes can alter the mean sea-level in an estuary or bay by amounts which depend on the form of the shore-line, the direction of prevailing winds, and other factors, and which may in favourable circumstances be so great as a number of inches. Observations of mean sea-level in Jamaica Bay near New York have disclosed local inequalities, while the level inside differs from that outside by from three-quarters of an inch to two inches—in close agreement with the predictions made in a theoretical study of the local conditions.

Heat Insulators.—Special Report No. 35 of the Food Investigation Board deals with heat insulators, contains nearly 100 pages, and is issued at 2*s.* 6*d.* (London: H.M. Stationery Office). It covers the whole of the work done on the subject by Dr. E. Griffiths at the National Physical Laboratory, for the heat insulation sub-committee of the Board since its formation in 1918. Almost every known type of cork, wood, powder, rubber, and fibre has been investigated, and the general conclusion is that for refrigeration purposes there are several materials which possess the necessary mechanical strength, do not too readily absorb moisture, and the heat conductivity of which does not exceed 0·00010 in c.g.s. units.

Amorphous Carbon.—A preliminary investigation of the anomalous diamagnetism of graphite, described by S. Paramasivan in the August number of the *Indian Journal of Physics*, is of interest in its bearing on the problem of the nature of amorphous carbon. Specimens of the latter which had been prepared from very different sources—naphthalene, anthracene, sugar, coal gas, wood charcoal, and two kinds of coal—all had a specific diamagnetic susceptibility close to that of diamond ($0{\cdot}5 \times 10^{-6}$), whilst only one body examined, graphitic anthracite, had an appreciably higher susceptibility ($0{\cdot}97 \times 10^{-6}$), and even that was well below the number for pure graphite ($4{\cdot}2 \times 10^{-6}$). There is some evidence that the susceptibility of graphite is less when it is finely divided than when it is in a massive state, and the X-ray investigations that have been made of similar bodies tend to show that a graphitic structure develops in course of time if rearrangement of the atoms is facilitated by heat, but the immediate conclusion to be drawn from the present experiments is that, so far as its magnetic properties are concerned, freshly prepared amorphous carbon is practically indistinguishable from diamond.

Quadrivalent Tellurium Derivatives.—In 1920, Vernon obtained two different forms of dimethyl telluronium iodide, Me_2TeI_2, and explained these as space isomers in which the valencies of the tellurium were in one plane:



In the March number of the *Journal of the Chemical Society*, however, H. K. K. Drew showed that the first compound is normal, and in it the valencies are probably directed towards the vertices of a regular tetrahedron, as in methane, whilst the second compound was not a true isomer but a complex substance, of salt-like character, having the same empirical formula. This was extended to similar compounds. In the September number of the same journal, Prof. Lowry and F. L. Gilbert review the properties of quadrivalent derivatives of tellurium in the light of Drew's formulæ, which they accept in their main features, although they consider that the properties of the two types of compounds are not so sharply separated as Drew suggested. They consider, from other evidence, that the complex form may have either the formula proposed by Drew, namely, $[TeMe_3]^+[TeMeI_4]^-$, in which all the halogens and methyl groups are covalently linked to tellurium, or $TeMe_3I$, $TeMeI_3$, corresponding with a mere aggregate or double salt of the two components. This explains the colours of some of the compounds. The authors give the results of experiments on the absorption of light by the compounds as well as the conductivities, which support their assumptions.

Pulverised Fuel in Electric Power Stations.—The paper on the modern use of pulverised fuel in electric power stations, by R. A. Chattock, the electrical engineer to the Birmingham Corporation, which is published in the *Journal of the Institution of Electrical Engineers* for October, is a very timely one. Mr. Chattock gives the results of experiments carried out in Birmingham which demonstrate that the use of pulverised fuel gives a higher combustion heat efficiency in the boilers than that obtained by mechanical stokers. With pulverised fuel firing a much larger proportion of the ash appears in the form of fine dust, the bulk of which is carried away by the waste furnace gases. The ash consequently is now becoming more apparent and is objectionable. With stoke fired boilers a coarse grit is carried out of the chimneys and is deposited in the immediate neighbourhood. After trying various experiments the 'cyclone' catcher was adopted, and it is found that this catches 90 per cent of the dust that formerly escaped up the chimney. With pulverised fuel boilers, however, the same type of cyclones only stopped about 35 per cent of the dust. What escaped was so fine that it was carried away to great distances and deposited over a very large area. At present two cyclones in series are being used which catch 75 per cent of the dust. It is hoped by washers and electrostatic catchers to increase this percentage very appreciably. The elimination of the sulphur products in the furnace gases is a new problem. Mr. Chattock thinks that it would be impossible to use only coals which contain very little sulphur, as he had to purchase coal from thirty or forty different pits and the proportion of sulphur in the coal varies considerably. Washing the gases is probably the simplest and best way of preventing both the emission of these products into the atmosphere and catching the dust.

Population Studies in South Africa.

DURING the recent meeting in South Africa of the British Association, Dr. J. E. Holloway, the Director of the Office of Census and Statistics, Pretoria, read an informative paper to Section F (Economic Science and Statistics) on "The Demographic Position in the Union of South Africa". Dr. Holloway pointed out that the Union of South Africa presents many interesting phases for the scientific study of population.

In the census of South Africa, the classification of the population is limited to four groups, namely: (1) European, (2) native, (3) Asiatic, and (4) other coloured, or for short 'coloured'. European refers to all people who are accepted as white, whether the original home is in Europe or not. White Syrians, for example, of whom there are some 2500 in the country, are included in this category. The term Asiatic refers chiefly to the descendants of indentured Indians introduced in the nineteenth century to work the Natal sugar estates. A certain number of Chinese and a few representatives of other races are also included. In 1921 the number of Asiatics in the Union was 165,731, and of these 97·3 per cent were Indians. The 'native' population comprises the various groups of Bantu, such as the Ama-Xosa, Fingos, Tembus, and Pondos of the Cape, the Zulus, the Basuto, the Bechuana, and numerous smaller groups found all over the Transvaal.

All coloured peoples not included in the terms Asiatic or native are comprised in the group 'other coloured'. The main constituent of this group consists of descendants of the Hottentots, admixed with a certain proportion of European blood. Their religion is for the most part Christian, their speech is Afrikaans, and politically they have come to be regarded in the Cape Province as on the same footing as the other white inhabitants. Descendants of Malay slaves imported during the seventeenth and eighteenth centuries also form part of this classification. At the Census of 1921 the 'coloured' population exceeded half a million and nearly 90 per cent were enumerated in the Cape Province.

The Dutch population being predominantly agricultural forms the bulk of the rural population, but the British preponderate in the population of all the larger towns except Bloemfontein and Krugersdorp, and of many of the smaller ones. The eastern province of the Cape, having obtained a large British settlement early in its history, is still largely British in rural as well as in urban areas. In Natal, British colonisation followed close on the Dutch, and the latter therefore effected very little permanent settlement. Those rural settlements in which less than 50 per cent of the population is of Dutch descent all occur in Natal and the eastern districts of the Cape. The only exceptions are Baberton and Pilgrim's Rest, which, being the two districts where the earliest gold discoveries in the Transvaal were made, attracted a British mining population.

Figures based on returns received at the population census of 1926 show that, in round numbers, 57 per cent of the Europeans were of Dutch-South African descent and 34 per cent were of British origin. The age distribution of the white races reveals some interesting facts. The population of Dutch descent predominates over that of British descent in all the age-groups except 45-49 years and 50-54 years. The population of Dutch descent in the age-groups 25-29 years and 30-34 years is practically equal, while a similar feature is evident for the British population in the age-groups 10-14 years and 15-19 years. The Dutch population preponderates at an increasing rate as the ages decrease. The first three features are the direct result of war. The preponderance of persons of British descent in the age adjacent to 50 years is caused partly by the immigration of young people of British stock after the Anglo-Boer war and partly by casualties on the republican side during the war. The stationary group around the ages 25-34 years in the Dutch group is due to the fall in births during the war and increased infant mortality. The stationary period in the British group is due to the absence of a large number of men on active service during the European War. The fourth feature must be ascribed to the relatively higher birth rate in the rural areas which are predominantly Dutch in character.

The so-called 'rural exodus' of which most countries complain has also its counterpart in the Union, though unlike Australia, huge urban communities have not developed in South Africa. In the Commonwealth, 43 per cent of the population lives in urban communities of more than 100,000 persons, whereas in the Union the corresponding percentage is 9. The same disproportion is noticeable in the urban and rural populations of the two countries; Australia showing 62 per cent urban as against 25 per cent for the Union. In the latter case, however, the lower percentage is mainly due to the fact that the Bantu are still largely country dwellers, only 12 per cent living in urban areas as compared with 56 per cent of the Europeans.

The urbanisation of the population of South Africa is on the increase, and this movement is proceeding more rapidly among the European than the non-European population. This increasing urbanisation of white population is held to be a result of the growth of a poor white landless population, and the tendency is therefore not regarded with equanimity. The last two censuses have shown not only a failure of the rural areas to absorb their own natural increase but also an actual absolute decrease of population in certain districts. This is notably the case in the eastern Karroo and the southern districts of the Orange Free State, where the uncertainty of the rainfall renders the prevailing pastoral industry somewhat precarious.

The densest native population is that which is concentrated for industrial purposes along the Witwatersrand and in Durban. The densest rural native populations centre on the Natal coast belt, in certain Transkeian districts and in Kingwilliamstown, Glen Grey, and Harschel. It becomes relatively less dense as one proceeds northwards and westwards. At the census of 1921, the Bantu population numbered 4,697,813, just three times the white population.

In conclusion, Dr. Holloway pointed out that the main question which is exercising the minds of South Africans in regard to population is that of the relative growth of the European and native populations. Very divergent estimates have been given by various authorities on the subject owing to the insufficiency of the statistical material at present available on the subject. Since 1921, a census of the European population has been held, but no new data are available in regard to non-Europeans. The line of attack indicated by the method of fertility statistics is not available, therefore, as the basic data are unprocurable for non-Europeans. The census of the total population which will be held in 1931 will throw a good deal of light on the subject, and the results of that census will therefore be awaited with the keenest interest.

The Pectic Substances of Plants.

KNOWLEDGE of the properties of the pectic compounds present in fruits and other plant tissues is of considerable practical interest: thus they play an important part in the setting of jams, in the fermentation processes of wine, beer, and cider, and in the preparation of textile fibres. They undergo changes during the ripening and senescence of fruit, or with the onset of disease, and hence are closely connected with problems of storage. Branfoot,[1] in a recent review of these compounds, classifies them into five groups: *pectose* is an insoluble compound of cellulose and pectin, present in the cell walls of tissues; it is of variable composition, since a variable number of the methoxy groups of pectin may be replaced by cellulose residues. *Pectin* is a neutral methoxy ester of pectic acid, and contains 11·76 per cent methyl alcohol; *pectinic acids* are intermediate between pectin and pectic acid, simple carboxyl groups replacing those esterified with methyl alcohol. *Pectic acid* is a complex of four molecules of galacturonic acid and one each of arabinose and galactose; methylpentose is possibly present in some pectic acids. Pectic acid forms salts of definite composition, of which that with calcium is insoluble and is useful in the estimation of the pectin content of plants. The simplest compound of the group is *metapectic acid*, which appears to be *d*-galactose-galacturonic acid.

Pectin and pectinic acids can be removed from the plant tissues by washing with water: pectose cannot always be extracted unchanged, and it is therefore usual to hydrolyse it first to pectin with dilute mineral acid. After treatment with water and acid there is still pectic material present in the middle lamella: this can be extracted by boiling with very dilute sodium hydroxide or by solution in dilute ammonium oxalate. For the preparation of pectose it is sometimes possible to dissolve out the cellulose with Schweitzer's reagent and thus obtain it unchanged, but in many plants this reagent also dissolves the pectose: pectin is precipitated from its solutions by alcohol, especially if acidified, whilst pectic acid can be prepared by the hydrolysis of pectin with sodium hydroxide, followed by addition of excess of acetic acid to dissolve out impurities, and calcium chloride to precipitate the insoluble calcium pectate. The pectic compounds can be estimated as pectin by precipitation with alcohol, but the method is not strictly quantitative, or better as calcium pectate after hydrolysis to pectic acid.

The distribution of the pectic substances in the cell walls and middle lamella of plant tissues can be followed by staining sections with ruthenium red before and after the application of known pectic solvents. They undergo definite changes during development and senescence, which can be well followed in fruits: the general course is a breakdown into nonpectic soluble bodies. The changes have now been so far worked out that it is possible by chemical and microscopical examination to gauge the stage of maturity of a given sample of fruit with considerable accuracy. These hydrolytic changes are due to the action of enzymes of which at least three have been described, a pectosase, a pectinase, and a pectase, producing respectively pectin and pectinic acids, pectic acid, and reducing sugars, etc. Similar changes occur in fungal and bacterial diseases and are presumably due to enzymes secreted by the organisms.

[1] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 33: A Critical and Historical Study of the Pectic Substances of Plants. By M. H. Branfoot (M. H. Carré). London: H.M. Stationery Office, 1929. 3*s*. 6*d*. net.

Locomotive Firebox Stays and Plates.

FROM relatively early days, the problem of the wastage of firebox stayheads has troubled successive locomotive engineers, who from time to time have devoted considerable attention to investigating its cause, with, however, little real success. In 1924 the British Non-Ferrous Metals Research Association, with the co-operation of all the British railway groups, commenced an exhaustive examination of the problem, a report on which has now been published by the Institute of Metals. The main conclusions of the authors of the paper, Messrs. O. F. Hudson, T. M. Herbert, F. E. Ball, and F. H. Bucknall, may be summarised as follows:

The wastage of stayheads is primarily due to oxidation of the copper which, though not serious under dry conditions, at once becomes so when leakage of water occurs. Apart from the effect of the water, an oxide scale is formed which, being hard and tenacious, causes little trouble. As a result of plastic deformation of the firebox plate and stay, however, due to the thermal stresses set up in service, leakage sets in, causing the detachment of the scale and exposing fresh surfaces to attack. Much speculation has existed in the past with regard to the actual temperatures attained at the stayhead and plate surfaces, but by inserting metallic plugs of known melting point in selected stays, the authors have shown that the temperature attained at the top of the firebox was of the order of 200°-250° C. with, perhaps, 300°-350° C. under the arch. In no instance was a temperature exceeding 350° C. observed.

The work, therefore, has been extended to discover an otherwise suitable alloy which at a temperature of 300° C. is not appreciably softened and will still possess an elastic limit of about 5 tons per sq. in. Of the materials so far examined, one of the most hopeful is a copper alloy with about 0·05 per cent of silver, which in the cold-worked condition had, after being annealed at 300° C. for 100 hours, a Brinell hardness of 73, an elastic limit of 7·2 tons per sq. in., and a tensile strength of 18·3 tons. That such material possesses all the ductility required is shown by the fact that the elongation on 2 in. is 36 per cent.

Considerable attention has been paid to the chemical nature of the oxidation of copper at high temperatures, and it is shown that the presence of small quantities of hydrochloric acid and sulphur dioxide, both more or less normal constituents of the firebox atmosphere, have a profound influence in accelerating the attack. Further, the conditions which determine the adhesion of the oxide to the metal have been carefully investigated. The presence of both soot and smoke is essential to the formation of a hard, adherent oxide of the nature of that produced on actual stayheads. A dark grey scale is then formed at 260° C., which readily withstands subsequent exposure to at least 400° C. without perceptible reduction of hardness or adherence. Such a scale would certainly not be removed by the abrasion encountered in a firebox.

Finally, experiments have been carried out on the effect of salts in the water. These have demonstrated that the detachment of scale from stayheads in service is independent of the composition of the leakage fluid, the presence of corrosive salts playing little part in the actual detachment of the scale.

F. C. T.

University and Educational Intelligence.

LONDON.—Mr. Charles Manning has been appointed, as from Jan. 1, 1930, to the Sir Ernest Cassel chair of international relations tenable at the London School of Economics.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the honorary degree of LL.D. on the following, on the occasion of the installation of Sir Wilfred Thomason Grenfell as Rector of the University on Nov. 6: Sir Wilfred Grenfell; Sir William Allardyce, formerly Governor of the Falkland Islands, of the Bahamas, of Tasmania, and of Newfoundland; Mr. H. M. Richards, senior chief inspector, Board of Education, London; Sir Arthur Steel-Maitland, late Minister of Labour; and Mr. J. E. Wrench, chairman and editor of the *Spectator*.

THE following scholarships have been awarded by the Council of the Institution of Naval Architects: Fairfield Scholarship in Naval Architecture (1929), £150 a year for four years at the University of Glasgow, to Mr. Samuel M'Murray, of Messrs. Harland and Wolff, Belfast; Denny Scholarship in Naval Architecture (1929), £75 a year for four years at the University of Glasgow, to Mr. C. R. Wynne-Roberts, of Bedford School, Bedford; Parsons Scholarship in Marine Engineering (1929), £150 a year for three years at the City and Guilds (Engineering) College of the Imperial College of Science and Technology, London, to Mr. F. L. Weatherdon, of H.M. Dockyard, Devonport.

WE have received from the Education Section of the British Psychological Society, and from the Child-Study Society of London, copies of memoranda on courses of study in junior schools, prepared at the request of the Consultative Committee of the Board of Education. The Education Section of the B.P.S. makes three recommendations: it is of the greatest importance that psychological grouping should take the place of chronological grouping; the development of the concrete real interests of the children should supersede the hard-and-fast school 'subjects'; and the school should be staffed with teachers who may be safely encouraged to experiment in both curriculum and method, and will be able to make educational use of local and individual interests, whilst keeping a universal, humane, and practical outlook. The report is signed by Mrs. Susan Isaacs and Miss Margaret McFarlane, as chairman and secretary, and may be regarded as authoritative. The Child-Study Society, taking its stand on the principle that in every educational problem the child's point of view should always be taken into account, urges that in the junior school place should be found for subjects which prove stimulating to the child, such as handicrafts, art, music, dancing, acting, organised games. It suggests rambles for Nature study, pictures and dramatisation in history; that models and slides in geography are useful devices that should be abundantly used; and, indeed, that all the resources of modern pedagogy should be drawn on to make work in the junior school vivid, intelligible, and memorable. The memorandum also lays particular stress upon the importance of the junior school taking over the essential features of individual methods, the success of which in the infant school is now beyond question, though at the same time exploiting to the utmost the newer methods in collective teaching, which allow and even encourage the more brilliant scholars to make their own pace. The memorandum is issued by Dr. C. W. Kimmins and Dr. P. B. Ballard, as chairman and vice-chairman of the council of the Society.

Calendar of Patent Records.

November 2, 1847.—An improved method of making gelatine medicinal capsules, which was widely adopted later, was probably the invention of a French chemist but was patented in England in the name of James Murdock, the patent agent, on Nov. 2, 1847. The capsule was made in two similar parts, formed by dipping the end of an iron rod of the required dimensions and shape into a solution of gelatine, one part fitting into the other and the two being hermetically sealed together by moistening the overlapping edges. The inventor preferred to use a vegetable gelatine produced from a species of marine moss.

On the same day, Nov. 2, 1847, Anthony Bernard von Rathen, civil engineer, was granted a patent for a compressed air motor-car. A car was built to his specification in the workshops of the Putney College of Civil Engineering and publicly tried on the road between Putney and Wandsworth in August 1849, when it attained a speed of from 8 to 12 miles an hour. Nothing further is known of the machine.

November 3, 1817.—The process of 'gassing' thread and lace, which greatly increased the English lace-trade in the early part of the nineteenth century and rendered it capable of competing with the continental trade, was the subject of the patent granted to Samuel Hall on Nov. 3, 1817, for a "method of improving every kind of lace or net, whether fabricated from flax, cotton, wool, silk, or other substances". The lace is passed over a flame with a motion sufficiently rapid to singe the woolly fibres covering the fabric without injuring the texture of the lace.

November 5, 1895.—A patent that greatly hindered the development of the American motor-car industry was that granted to George B. Selden in the United States on Nov. 5, 1895, which had been applied for in 1879 and thus took sixteen years for the examination before it was finally sealed and the patent rights began to run. The Electric Vehicle Company secured the rights and enforced them, with the help of some of the prominent makers, by charging a royalty of one per cent of the selling price on every petrol vehicle produced in the United States. The patent was upheld in the lower court, but Henry Ford took it to the Circuit Court of Appeals and won his case, the previous decision being reversed.

November 7, 1789.—The patent granted to Ralph Gout, clockmaker of London, for "certain machinery for the purpose of measuring distance, which will ascertain with the greatest precision the number of miles a person travels", on Nov. 7, 1789, was for the first taximeter that appears in the records. The apparatus was in the form of a 'pedometer'—of which instrument also Gout was a patentee—connected by levers and wires with the running wheels of the vehicle.

November 8, 1721.—The first artificial fertiliser to be patented was the invention of John Piper and Matthew Tyndale, Jr., who on Nov. 8, 1721, were granted an English patent for "a certaine compound, consisting of prepared chalk and sea-water, which abundantly increaseth all manner of grain, pulse, and grass, beyond what hath been known".

November 9, 1786.—The patent granted to Joseph Geib, musical instrument maker of London, on Nov. 9, 1786, for "a new improvement upon the pianoforte and harpsichord by which the same will become perfect and compleat instruments of their kind, which have never before been discovered, and by which the same can be more easily tuned and played upon", introduced the 'hopper escapement' for square pianos. The new mechanism was first brought out by Longman and Broderip, of Cheapside, the predecessors of Collard and Collard.

Official Publications Received.

BRITISH.

Journal of the Indian Institute of Science. Vol. 12A, Part 8: i. Studies in Enzyme Action, Part 3, Amylase from Cumbu (*Pennisetum typhoideum*), by D. Narayanamurti, C. V. Ramaswami Ayyar and Roland V. Norris; ii. Studies in Enzyme Action, Part 4, Tyrosinase, I., by D. Narayanamurti and C. V. Ramaswami Ayyar. Pp. 105-129. (Bangalore.) 1.8 rupees.

Rubber Research Institute of Malaya. Bulletin No. 1: The Natural Coagulation of Hevea Latex. By Dr. A. S. Corbet. Pp. 17. (Kuala Lumpur.) 1 dollar.

Journal of the Federated Malay States Museums. Vol. 14, Parts 3 and 4, July. Pp. 325-481+plates 5-13. (Kuala Lumpur.)

Memoirs of the Archæological Survey of India. No. 41: Survival of the Prehistoric Civilisation of the Indus Valley. By Ramaprasad Chanda. Pp. iv+40+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 2*s*.

Malayan Forest Records. No. 7: Mangrove Bark as a Tanning Material. By T. A. Buckley. Pp. 40. (Kuala Lumpur.) 50 cents; 1*s*.

Royal Observatory, Hong Kong. Meteorological Records 1884–1928. (Appendix to Hong Kong Observations, 1928.) By C. W. Jeffries. Pp. 16. (Hong Kong.) 60 cents.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1928. Pp. iv+31. (Barbados.) 6*d*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 394, October. Pp. 1177-1268+xxxvi. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

FOREIGN.

Bulletin of the National Research Council. No. 69: Molecular Physics in relation to Biology. Report of the Subcommittee on Molecular Physics, of the National Research Council. Pp. 293. 3 dollars. No. 70: Studies of Mean Sea-Level. Report of the Committee on Shoreline Investigations, National Research Council. Pp. 50. 50 cents. No. 71: Bibliography of Bibliographies on Chemistry and Chemical Technology. First Supplement 1924–1928. Compiled by Clarence J. West and D. D. Berolzheimer. Pp. 161. 1.50 dollars. (Washington, D.C.: National Academy of Sciences.)

Reprint and Circular Series of the National Research Council. No. 89: Science and Progress in the Industries. By John J. Carty. Pp. 8. (Washington, D.C.: National Academy of Sciences.) 20 cents.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 88: Myths and Tales of the Southeastern Indians. By John R. Swanton. Pp. x+275. 1.00 dollar. Bulletin 90: Papago Music. By Frances Densmore. Pp xx+229+19 plates. 1.25 dollars. (Washington, D.C.: Government Printing Office.)

Mededeelingen van het Nederlandsch Instituut voor Documentatie en Registratuur. No. 6, 1928, 10-12. Pp. 2073-2249. (Amsterdam: Nederlandsch Instituut voor Efficiency.) Bi-monthly, 50*s*. a year.

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 12, 1928. Pp. 265+vii. (Rochester, N.Y.: Eastman Kodak Co.)

Department of Commerce: Bureau of Standards. Research Paper No. 78: Relative Visibility of Luminous Flashes from Neon Lamps and from Incandescent Lamps with and without Red Filters. By F. Chapin Breckenridge and J. E. Nolan. Pp. 11-25+1 plate. 5 cents. Research Paper No. 84: Bunsen Flames of Unusual Structure. By Francis A. Smith and S. F. Pickering. Pp. 65-74+5 plates. 5 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUE.

Watson's Microscope Record. No. 18, September. Pp. 32. (London: W. Watson and Sons, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 1.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—W. M. Mollison, G. J. Jenkins, L. Graham Brown, and J. P. Stewart: Triumphs and Failures of the Mastoid Operation.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—J. G. Pearce: Modern Engineering Cast Irons and their Properties.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Cyclonic Disturbances of Sea Level. Chairman, Sir Richard Gregory. Speakers, Dr. Doodson and Prof. Proudman.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Cases by W. S. T. Neville, Dr. D. McKenzie, V. E. Negus, H. A. Kisch, T. B. Layton, and others.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Spinal Deformities in the Sacroiliac Region.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Burn: The Development and Performance of the Richardsons-Westgarth Oil Engine.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society) (at Engineers' Club, Manchester), at 7.—Dr. F. A. Freeth: Industrial Research.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7.—E. W. Hill: Chairman's Inaugural Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Conversazione.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Alfred Herbert, Ltd.: Technical Film: The Age of Speed.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Words and Names.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. J. Blomfield, Sir Francis Shipway, and others: Discussion on Avertin Anæsthesia.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—J. W. Berry: Cold Working of Metals.

SATURDAY, NOVEMBER 2.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—A. H. Allcroft: The Significance of Circular Churchyards.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—J. Litchfield: Lace, its Characteristics, Technique, Classification, and Yarn Requirements.

MONDAY, NOVEMBER 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. Frances M. Ballantyne: Notes on the Development of *Callichthys littoralis*.—Dr. A. W. Greenwood: Some Observations on the Thymus Gland in the Fowl.—Dr. A. C. Fraser and Dr. B. P. Wiesner: Variations of the Rest Metabolism of the Rat in Relation to the Sex Cycle.—Dr. L. Mirski: On the Presence of a Kothyrogen Substance in the Mouse Placenta.—Dr. B. P. Wiesner: On the Mechanism of the Diphasic Sex Cycle.—Prof. H. W. Turnbull and Dr. J. Williamson: Further Invariant Theory of Two Quadratics in n Variables.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens of Cysts.

ROYAL INSTITUTION, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—G. A. Wright: Land Drainage.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss K. Leopold: Creative Work and its Effect on Appreciation: An Experiment in the Teaching of Poetry.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—Capt. L. W. Johnson: The Inspection of Metals and their Alloys.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. Borlase Matthews and others: Discussion on Paris and the Pyrenees: Notes on some of the Technical Features of the I.E.E. 1929 Visit.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—J. Wright and C. W. Marshall: The Construction of the 'Grid' Transmission System in Great Britain.

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—A. Bailey: Artificial Silk and its Everyday Manufacturing Problems.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Burlington House), at 8.—N. Heaton: Titanium Oxide Pigments.—A. Marshall: The Vapour Pressures of Nitroglycerin and Dinitroethyleneglycol, and The Function of Sulphuric Acid in Nitrations.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H. G. Watkins: River Exploration in Labrador by Canoe and Dog Sledge.

SOCIETY OF DYERS AND COLOURISTS (Huddersfield Section) (at Huddersfield).—M. Carter: Dyeing of Indigo and Blue Serges.

TUESDAY, NOVEMBER 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. A. Arkwright: The Virulence of the Micro-organism in Infective Disease (Bradshaw Lecture).

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—Dr. C. E. Tilley: Scawtite, a New Mineral from Scawt Hill, Co. Antrim.—Dr. F. Coles Phillips: On the Composition-plane of [010]-twins in the Acid Plagioclases.—M. H. Hey: On the Variation of Optical Properties with Chemical Composition in the Rhodonite-Bustamite Series.—Dr. F. Coles Phillips: A Preliminary Account of some Mineralogical and Chemical Changes in the Green Bed Group of the Scottish Dalradian on Progressive Metamorphism.—E. Heron-Allen: Exhibition of a So-called Meteorite from Hangchow, Chekiang, China.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Major S. S. Flower: (*a*) Exhibition of a Fat Dormouse (*Glis glis*) from Hastoe, Herts; (*b*) Notes on a Recent Visit to some Continental Zoological Gardens.—W. S. Bristowe: (*a*) The Spiders of Skomer Island (S. Wales); (*b*) The Distribution and Dispersal of Spiders.—J. R. Norman: Notes on the Fishes of the Suez Canal.—E. Banks: Interbreeding among some Bornean Leaf-Monkeys of the Genus *Pithecus*.

INSTITUTION OF CIVIL ENGINEERS, at 6.—W. W. Grierson: Presidential Address and Presentation of Medals.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.—E. C. Stuart Baker: The Animals and People among whom we carry on our Natural History Work in the Jungle of India.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Dr. P. Macgillivray: D. O. Hill and his Work.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates) (jointly with Coventry Graduates) (at Broadway Café, Coventry), at 7.15.—Discussion: That Mass Production is Detrimental to the Industry.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Iron and Steel Institute) (at Royal Society of Arts), at 7.45.—Dr. W. H. Hatfield: Steels for Automobiles and Aeroplanes.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 8.—Miss C. H. Spencer: Colloids (Presidential Address).

TELEVISION SOCIETY (at Engineers' Club, Coventry Street, W.1), at 8.—F. Langford-Smith: Amplification and Television.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—D. McCrae Aitkin: Respiratory Rhythm in Physiological Relation to Movement and Posture, with Suggested Applications to Treatment (Presidential Address).

WEDNESDAY, NOVEMBER 6.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. Bolton: Fossil Insects of the South Wales Coalfield.—Major A. R. Dwerryhouse and A. A. Miller: The Glaciation of Clun Forest, Radnor Forest, and some Adjoining Districts.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. C. E. Kennedy-Purvis: Chairman's Inaugural Address.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—R. Grierson: Electric Warming, with Special Reference to Low Temperature Panel Systems.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—H. A. Morham: Chairman's Address.
BACUP TEXTILE SOCIETY (in Natural History Rooms, Bacup), at 7.30.—A. Anderson: Automatic Looms.
HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—T. W. Hanson: The Early Days of the Woollen and Worsted Industries.
SOCIETY OF GLASS TECHNOLOGY (London Section) (at Osram G.E.C. Glass Works, North Wembley), at 7.30.—Discussion: The flow of Glass in Tanks.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—E. R. Bolton and K. A. Williams: The Grouping of Fatty Oils, with Special Reference to Olive Oil.—Dr. C. Dukes: The Heat Resistance Curve: A New Bacteriological Test for Pasteurised Food.—W. R. Mummery and F. Bishop: A New Borax Solubility Test for Lactic Acid or Natural Sour Casein.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL SOCIETY OF ARTS, at 8.30.—Ll. B. Atkinson: Fifty Years of Electrical Science and Industry.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—H. Cairns and others: Discussion on Surgery of the Spinal Cord.
HASLINGDEN DISTRICT TEXTILE SOCIETY (at Grammar School, Haslingden).—J. H. Townson: Taylor Lang's Treble Spindle Speed Condenser Mule.

THURSDAY, NOVEMBER 7.

ROYAL SOCIETY, at 4.30.—W. A. Lamborn: The Remarkable Adaptation by which a Dipterous Pupa (Tabanidæ) is preserved from the Danger of Fissures in Drying Mud.—Prof. H. E. Roaf: The Absorption of Light by the Coloured Globules in the Retina of the Domestic Hen.—R. G. Tomkins: Studies of the Growth of Moulds (I.).—R. H. Stoughton: The Morphology and Cytology of Bacterium Malvacearum E.F.S.—E. C. Smith: On the Coagulation of Muscle Plasma.—*Papers to be read in title only:*—Dr. Sunder Lal Hora: Ecology, Bionomics, and Evolution of the Torrential Fauna.—N. J. Berrill: Studies in Tunicate Development. Part I.—J. C. Kernot, J. Knaggs, and Madge Kaye: The Swelling of Fish Skins in Solutions of Inorganic and Organic Acids.—Prof. A. V. Hill: Anaerobic Survival in Muscle.—Prof. A. V. Hill and P. Kupalov: Anaerobic and Aerobic Activity in Isolated Muscle.—Sybil Cooper and Dr. D. Denny-Brown: The Interaction between two Trains of Impulses converging on the Same Motoneurone.—C. H. Best and Ruth Partridge: Observations on Olympic Athletes.—H. S. Holden: On the Structure and Affinities of Ankyropteria Corrugata.—W. R. I. Cook and E. J. Schwartz: Life-history, Cytology, and Method of *Plasmodiophora brassicæ* Woron, the Cause of Finger and Toe Disease of Cabbages and other Crucifers.—Dr. R. Broom: On the Structure of the Mammal-like Reptiles of the Suborder Gorgonopsia.—H. K. Mookerjee: (*a*) On the Development of the Vertebral Column of Anura; (*b*) On the Development of the Vertebral Column of Urodela.—Prof. R. R. Gates and F. M. L. Sheffield: Megaspore Development in Œnothera Rubricalyx.—C. F. A. Pantin: On the Physiology of Amœboid Movement. (I., II., and III.).—Dr. O. Rosenheim and Dr. N. K. Adam: Monomolecular Films of Irradiated Ergosterol in Relation to the Production of Vitamin D.—R. N. Mukerji: Effect of X-Radiation on the Spermatogenesis of Lepisma Domestica.—Prof. J. B. Gatenby, R. N. Mukerji, and Sylvia Wigoder: The Effect of X-Radiation on the Spermatogenesis of Abraxas Grossulariata.
LINNEAN SOCIETY OF LONDON, at 5.—Dr. D. H. Scott: Exhibit of Fossil Seeds of *Eospermatopteris*, the Oldest Known Spermophyte.—Dr. H. Scott: A Natural History Excursion into Basutoland.—Prof. G. E. Nicholls: *Micraspides calmani*, a New Syncaridan from the West Coast of Tasmania.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. F. Still: The History of Pædiatrics in the Seventeenth and Eighteenth Centuries (FitzPatrick Lectures) (I.).
ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 5.30.—Prof. A. C. Ukil: Epidemiology and Pathology of Tuberculosis in India.—Dr. G. Giglioli: Paratyphosus C. Infections in British Guiana.—Dr. W. Broughton-Alcock: Section Showing Structures Morphologically Resembling Spirochætes of a Species Common to the Mouth, Lying Deep Within the Mucous Membrane.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. A. E. Dunstan: Recent Developments of Fuels and Dopes for Aircraft Engines.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—T. G. Elliot and R. J. Sarjant: Recent Developments in Corrosion and Heat Resisting Steels.
BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7.30.—J. Brooke: Practical Hints on Carding.
CHEMICAL SOCIETY, at 8.—F. Challenger, C. Higginbottom, and A. Huntington: The Nitration of Aromatic Thiocyanates.—F. Challenger and A. D. Ainley: Studies of the Boron-carbon Linkage. Part I. The Oxidation and Nitration of Phenylboric Acid.
INSTITUTION OF MECHANICAL ENGINEERS (Manchester Centre) (at Manchester).—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).
NELSON TEXTILE SOCIETY (at Nelson).—H. Holt: Defects in Yarns and how to try to avoid them.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow).—Lt.-Col. Sir Arnold Wilson: A Central Building for Technical Institutions.

FRIDAY, NOVEMBER 8.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—G. Smith: The Mildew Problem in the Cotton Industry.
ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. M. Green: The Indian Cinema Industry.
ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. E. A. Milne: The Masses, Luminosities, and Effective Temperatures of the Stars.—Prof. A. S. Eddington: Internal Circulation in Rotating Stars.—Dr. H. Spencer Jones: A Revision of Newcomb's Occultation Memoir.—R. A. McIntosh: (*a*) The Meteor Swarm of Halley's Comet; (*b*) Observations of the Orionid Meteors.—Prof. A. S. Eddington and S. Plakidis: Irregularities of Period of Long Period Variable Stars.—Report of the British Expedition to Observe the Total Solar Eclipse of 1929, May 9.
PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. Sir C. V. Raman: Diamagnetism and Molecular Structure (Lecture).
MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.
ILLUMINATING ENGINEERING SOCIETY, at 7.—W. H. Villiers and S. G. Double: Modern Incandescent Lighting in Kinema Studios.
INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Section) (at 36 George Street, Manchester), at 7.—E. M. Cass: Undue Compression in the Cylinders of Steam Locomotives and Means of Combating Same.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.
LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—J. Morris: Cotton Spinning and Doubling.
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. Orme: Nickel-Silver.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Liverpool).—Dr. Fox: Some Reminiscences of a Government Laboratory.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Thomas' Café, Swansea).—H. J. Hodsman: Smokeless Fuels and how they burn.
NATIONAL SMOKE ABATEMENT SOCIETY (at College of Technology, Manchester).—A. McCulloch: Coal and its Combustion.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 1.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Tissue Anarchy (Harben Lectures) (III.).
BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Nervous System in Relation to Health (Chadwick Lecture).
ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Prof. G. Elliot Smith: The Evolution of Man.

SATURDAY, NOVEMBER 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Sculpture in Relief.

MONDAY, NOVEMBER 4.

UNIVERSITY COLLEGE, at 2.—Prof. L. N. G. Filon: Cosmography in the XVIth Century.—At 5.—Prof. Sir C. V. Raman: The Molecular Scattering of Light. (Succeeding Lectures on Nov. 5 and 7.)
GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Nov. 6, 7, and 8.)

TUESDAY, NOVEMBER 5.

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. M. Ginsberg: The Contribution of Prof. Hobhouse to Philosophy and Sociology.
KING'S COLLEGE, at 5.30.—Mrs. N. A. Duddington: Russian Philosophy at the Present Time.

WEDNESDAY, NOVEMBER 6.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—S. Cade: The Possibilities and Limitations of Radium Treatment.
KING'S COLLEGE, at 5.30.—Prof. D. M. Blair: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Medical Science.—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality—The Approach to Transcendental Reality.
ROYAL VETERINARY COLLEGE, at 5.30.—Major G. W. Dunkin: Immunisation against Distemper in the Dog. (Succeeding Lectures on Nov. 13 and 20.)

THURSDAY, NOVEMBER 7.

KING'S COLLEGE, at 3.—C. J. Gadd: The Babylonian Background of the Captivity.
LONDON SCHOOL OF ECONOMICS, at 5.—Prof. L. Robbins: The Present Position of Economic Science.
UNIVERSITY COLLEGE, at 5.30.—Viscount Grey of Fallodon: Natural History, the Pleasure and Purpose of Observation (Rickman Godlee Lecture).

FRIDAY, NOVEMBER 8.

LONDON HOSPITAL MEDICAL COLLEGE, at 4.30.—Dr. A. F. Hurst: Precursors of Carcinoma of the Stomach (Schorstein Memorial Lecture.)

SATURDAY, NOVEMBER 9.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—G. T. Clark: Geometry—Boys, Girls, Us.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Wild Flowers in London's Open Spaces.

CONFERENCE.

NOVEMBER 1 TO 3.

LEPLAY HOUSE AND THE SOCIOLOGICAL SOCIETY.

Public Library

NATURE

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The Grant of Invalid Patents.

BRITISH justice is a pearl of great price. More specifically it may be stated that in the case of patent actions in the High Court its price ranges from £600 to £1000 a day, and that such actions may last for a number of weeks. Dr. Levinstein has performed a public service in giving prominence, in his recent address to the Bristol section of the Society of Chemical Industry, to this costliness, which is a fundamental defect in the British patent system. Owing to the high cost of patent litigation, to which he referred in language warmed by bitter experience, the consideration for which patent rights may be enjoyed is nowadays not so much the introduction of a new invention as the possession of exceptional wealth. A genuine inventor cannot, unless he be supported by very large financial resources, prevent his invention from being freely copied: for his only remedy lies in an action for infringement, and this might cost him a fortune, even if he succeeded in winning it. On the other hand, a bogus invention, embodied in an invalid patent, can be used to hamper manufacturers or to extract royalties in a manner which is scarcely distinguishable from blackmail. "Thousands of unjustified monopolies are being legally granted," says Dr. Levinstein, "and sometimes the holders threaten the very existence of those invading their privilege."

Some time ago it was estimated that there existed in Great Britain about 105,000 live patents, of which 33 had been tested in the Courts and found valid, while an equal number of coeval patents had been found invalid. Of the remainder, a large proportion must certainly have been invalid. "Is it not an abominable restraint of trade", asks Dr. Levinstein, "that we are fettered annually by the State with this enormous number of monopolies which, if exercised, would be improperly exercised? Lying unexercised, each one is a latent danger to the merchant adventurer, an unnecessary peril of the sea of discovery."

Various remedies have been proposed for this unfortunate state of things. The British Science Guild, in a report which has formed the basis of all recent discussions of patent law reform, made a number of proposals which would mitigate the evil to a certain limited extent. It suggested, for example, that the law with regard to unjustifiable threats should be strengthened, and that the Comptroller should be empowered to try infringement actions by consent of the parties. But the latter provision could not prevent the abuse of

wealth to which reference has been made. It is true that actions before the Comptroller are cheap: counsel accept lower fees, the procedure is more expeditious, less expert evidence is needed for explaining technicalities to the tribunal. A High Court action probably costs hundreds of times as much as an opposition before the Comptroller, and the latter form of proceedings is coming to be used as a cheap method of obtaining an official opinion on validity. But the trial of an infringement action before the Comptroller would not be either compulsory or free from the right to appeal, so that either of the parties could insist on going to the High Court if he wished to ruin his opponent.

The remaining remedies recommended by the British Science Guild aim at reducing the number of invalid patents granted annually by the Patent Office: it is suggested that that office should be empowered to enforce a stricter standard, at least in respect of novelty, before granting a patent. Such a provision would, to some extent, diminish the abuses which are founded on the high cost of patent litigation; but that result could be completed only if, after an adequate official scrutiny, the sealing of a patent were deemed to confer validity upon it as regards some specified issues. Alternatively, validation in respect of these issues might be conferred after a lapse of some years, as in certain foreign countries. Dr. Levinstein makes the converse proposal that the grant of a patent should confer the right to work it. This would necessitate an official search among the claims of all relevant live patents, acknowledgment of master patents, and recognition of third party rights when grants have been made in error.

From the legal profession such proposals could only meet with scandalised disapprobation. To deprive an Englishman (or a foreigner trading with Britain) of his inalienable right to embark upon ruinous litigation, or to inflict ruinous litigation on his neighbours, seems to be subversive of the natural rights of man. The justice dispensed by the High Court and the Lords of Appeal seems to be something which every citizen has a theoretical right to invoke, even if the recognition of that right tends to promote blackmail. Unfortunately, we have to choose between an ideal justice, accessible only to millionaires, and some more rough-and-ready form of that commodity, less infallible but more serviceable to the ordinary conduct of industry. Let us therefore examine some of the issues which have to be considered by the High Court when it determines the validity of a patent, and ask what would be the consequence of allowing them to be settled administratively, after an adequate scrutiny, at the time when a patent is sealed or after the lapse of a given interval.

One of these issues is 'novelty' as determined by documentary evidence; prior user, which arises less frequently in modern litigation, would need to be discussed separately. Every patent agent and every examiner in the Patent Office construes hundreds of specifications in the course of a year. The number of documents relating to his special industry which he construes, and his familiarity with the technical details of that industry, far exceed the equipment in these respects of a High Court judge, who may never have turned his attention to the subject until it is explained to him by expert witnesses. The issue is one which requires technical understanding rather than profound legal knowledge. Provided, therefore, that the novelty of the inventions were first investigated as fully as might be practicable, more good than harm would be done if the sealing of a patent were deemed to confer, immediately or after an interval, immunity from attack on the issue of documentary anticipation. Mistakes would presumably be made by the Patent Office from time to time: but the evils arising from such mistakes would be far less serious than the evil arising from the uncertainty which prevails as to the validity of patents.

We come to the issue of 'subject-matter'. The *quale* of subject-matter is already handled by the Patent Office, which may grant patents only for inventions having the nature of a manufacture. *Quantum* of subject-matter, on the other hand, is an issue reserved entirely for the Courts: in order that a patent may be valid, the invention which it protects must differ from previous inventions, and from previous industrial practice, to such an extent that inventive ingenuity was necessary in the devising of it. Normally this issue is identical with that of novelty: only in border-line cases, where the inventive step is very small, does it become difficult to determine whether the required degree of inventive ingenuity is present or not.

The matter has been rendered mysterious by a legal fiction to the effect that inventive ingenuity is something which must be either present or absent: that it can be ascertained qualitatively and not quantitatively. As a matter of fact there are infinite gradations of ingenuity: a sparrow exercises a scintilla of ingenuity when it fits a nest into a hole of new and unfamiliar shape. Since the quantitative standard of ingenuity necessary for a valid patent is thought of as qualitative, each judge and each expert witness refers unconsciously

to his own arbitrary and independent standard. The problem is stated by asking whether a skilled workman, possessed of the knowledge which was common at the date of a given invention, could have devised the latter without exercising ingenuity. The conundrum to be solved by the learned Court is almost as difficult as that scholastic one, *utrum chimæra, bombinans in vacuo, comedere possit secundas intentiones?* The Court has to ascertain what might have been done a long time ago by a fictitious workman, in circumstances which never occurred, with the aid of an abstraction called 'common knowledge' the limits of which nobody can any longer remember, and subject to an undefined quantitative restriction which is erroneously apprehended as qualitative.

As might be expected, the judicial decisions in these matters are uncertain and conflicting. In Bonnard *v.* L.G.O.C., for example, the three judges of the Appeal Court were just as unanimous in attributing ingenuity to the invention as the five Law Lords were in denying it. Such issues could be settled more inexpensively by the tossing of a coin; and as they arise when the invention is of small extent and therefore of small merit, no great injustice could be done if they were settled adversely before the sealing of a patent. Administrative settlement of the issue would be particularly suitable if the present standards of 'subject-matter' were to be raised, and if inventions which did not reach the new standard could be made the subject of short-term patents. Mistakes would be made, inevitably: some deserving inventors would have to content themselves with short-term patents having the disadvantage of very narrow claims. But the injustice done in this way would be negligible in comparison with that which arises from the issue of floods of paper patents the validity of which is uncertain. "I am convinced", says Dr. Levinstein, "that the time to determine the state of common knowledge is before the grant of a patent, not years later: the place the Patent Office, not the Law Courts." Moreover, if mistakes are to be made, let them be made at an early stage, before a man has risked his capital on a perilous venture.

Another issue frequently fought out in Court is that technically known as 'utility': the Court has to decide whether the invention, in so far as it is described in the specification, is practicable.

In the case of mechanical and electrical inventions it is very often possible to determine, without experimental trial, whether these inventions are in principle practicable or not: but this is not always possible, and in the case of chemical inventions it is rarely possible. It was suggested, however, by the late Dr. Ehrhardt that upon an inventor's furnishing the Patent Office with satisfactory evidence of the sufficiency of his description and the practicability of his invention, his patent should be relieved from the risk of subsequent invalidation on those issues. The proposal is by no means free from objection, but even so, it is possible that the evils arising from an attempt to settle 'utility' at an early stage might be less than the evils which actually arise from uncertainty as to the validity of the 20,000 patents which are so light-heartedly granted every year by the Crown.

The above proposals will seem to members of the legal profession to merit nothing but contempt. But it must be remembered that—apart from the question how far technical inventions can be really understood by a non-technical court—the judicial system is only valuable in so far as it is available for use. Its high cost prevents it from being available to any but the very wealthiest litigants, and makes it possible for them to defeat the ends of justice. What is needed is some more rough-and-ready method of weighing the validity of patents, some method which should be cheap enough to be generally useful even though it be not infallibly just. A miscarriage of justice early in the life of a patent may be of minor consequence, whereas at a later stage it may involve the loss of enormous capital outlay. If the issues of documentary anticipation and subject-matter, and possibly also utility, could be summarily settled, after an adequate investigation, at an early stage in the life of a patent, the advantage gained by the change would outweigh the disadvantage of occasional miscarriages of justice. A long step would have been taken in the direction of restoring the patent system to its legitimate function in the national economy of Britain.

Chemistry for Students and Others.

Everyday Chemistry. By Prof. J. R. Partington. Pp. viii + 668 + xiii. (London: Macmillan and Co., Ltd., 1929.) Pt. 1, 3*s.*; Pt. 2, 3*s.*; Pt. 3, 2*s.* 6*d.* Complete, 7*s.* 6*d.*

AMONG the easiest tasks to conceive, and yet one of the hardest adequately to perform, is the production of an introductory text-book of chemistry such as shall faithfully expound the unchanging, but always fashionably dressed, principles of the science, shall include what is necessary of formal instruction concerning material facts and observations, and at the same time shall have

about it an air of freshness and vitality, a reflection of the author's own interests and personality. The text-book has perforce to be measurable in terms of the standard of instruction demanded by public examinations, and in orienting himself to this horizon any author is bound to preserve a substantial measure of conventionality in his treatment. If, as is here the case, the author looks beyond classroom walls and desires to include in his audience, without segregating them in the gallery, perfectly ordinary and knowledgeable but less purely scholastic people, his information is most easily assimilable if it is correlated with common affairs, and his illustrations most effective if they are largely borrowed from everyday human experience.

Prof. Partington has steadfastly held in view both these aims, and in his able and experienced hands the substance of the book has been collected and welded together most skilfully, most pleasantly, and most usefully, resulting in a real text-book of dimensions and cost suitable to college or arm-chair use. He has striven to introduce people to chemistry as it appears to-day rather than to popularise chemistry for the people as they appear to him ; he does not flutter abstractedly from one alluring subject to another, but sets things down decently, attractively, and in order, the result being a happy combination of the old and the new, of the formal and the informal, of philosophy and technology. The index failed at a random test; the text is worth one which, for example, includes 'iodine', 'food', and 'explosives' (524), as well as 'explosion' (452), and does not suggest that 'gas mantle' (43) and 'Welsbach mantle' (431) are distinct entries. Why, incidentally, need 'sulphuretted hydrogen' be perpetuated when the term, like cotton hose and the last-but-one atomic theory, is obviously out-of-date ?

In view of the increasingly widespread conviction that the burning of raw coal in open grates is both wasteful and injurious, owing to the pollution of the atmosphere which, especially in densely populated areas, the practice occasions, and with public determination to preserve, so far as possible, the amenities of the districts adjacent to the sites of great power stations, the paragraph on smoke abatement will be read with interest and, let us hope, resolution. By the more extensive use of gas and electricity, and by employing low-temperature coke in open grates, every reader can, without sacrifice of comfort, contribute to the solution of one of our national problems—the economic utilisation of coal—and at the same time to the advantage of the health of the community. Whilst industrial smoke is more amenable to abatement than domestic, the same considerations require that the appropriate treatment should be as rigorous and effective as possible. In London, domestic fires are estimated to be responsible for about seventy per cent of the atmospheric soot (the particles of which may contain from four to eight per cent of free sulphuric acid), whilst in industrial towns the figure is probably about thirty per cent. In the section on carbon monoxide, the results of determinations of the proportion of this poisonous gas (arising from the exhaust of automobiles) in the streets of Paris and in tunnels in the United States of America are quoted. Estimates of the carbon monoxide produced by small cars and large lorries are 41 and 184 cubic feet per hour, respectively, referred to a speed of 15 miles per hour ; had other figures been available, perhaps realism would have been better served by increasing the reference speed.

The author is not very romantic where the "romances of chemical industry" are concerned, for he declares, and no doubt with truth, that they are often fictitious, the 'discoveries' arising from forgotten patent specifications, or from publications in pure science. "Big business", he says, "usually arises from a little exhibition of genius in another place, and very often the scientific investigator who has made possible great and lucrative industrial undertakings has died in poverty." It may be added that, even if he has undertaken the expense of acquiring patent monopoly rights in Great Britain, the circumstance may be of little avail to the inventor himself, such are the opportunities under the existing law for financial might to dominate scientific claims. It is not without significance that two such influential bodies as the British Science Guild and the Association of British Chemical Manufacturers have taken up the matter with the view of securing a more equitable distribution of the rewards of service and industry. In fact, Dr. H. Levinstein, in his recent address before the Bristol section of the Society of Chemical Industry, declared that the time is approaching when the curtailment of patent monopolies will again become indispensable to the nation as it was three hnndred years ago, and that to remove the mass of bogus, bluff, blocking paper patents, valueless, but with a menace grinning through the paper mask, and to grant patents only after examination for real novelty and subject matter, would be of immense benefit to large and small industrial concerns as well as to the poor inventor.

The book under review is divided into three separate sections, namely: (1) Chemical history and theory, (2) some non-metallic elements and their important compounds, and (3) organic chemistry and metals. The inclusion of chapters on organic compounds, food, nutrition, and biochemistry, with paragraphs on food-values, vitamins, enzymes, immunology, explosives, essential oils, dyes, rubber, etc., is in harmony with the general conception of the book, as are references to X-ray spectra and the quantum theory. There is, however, no freakishness about the treatment, and the author will probably hit both birds at which he is aiming a single stone. One cannot, in conclusion, resist the temptation of asking the author why he chooses to write 'Bagdad' and 'ar-Rashid' instead of 'Baghdad' and 'al-Rashid', and whether he would resent being addressed by a follower of the 'prophet' Mohammed as 'Professor' Partington.

A. A. E.

The Vegetation of New Zealand.

(1) *Die Vegetation der Erde: Sammlung pflanzengeographischer Monographien.* Herausgegeben von Prof. A. Engler und Prof. O. Drude. Band 14: *The Vegetation of New Zealand.* By Dr. L. Cockayne. Second edition, almost entirely rewritten, thoroughly revised and enlarged. Pp. xxvi + 456 + 87 plates + 3 maps. (Leipzig: Wilhelm Engelmann, 1928.) 42 gold marks.

(2) *The Trees of New Zealand.* By Dr. L. Cockayne and E. Phillips Turner. Pp. 171. (Wellington, N.Z.: W. A. G. Skinner, 1928.) 4*s*.

(3) *New Zealand Trees and Shrubs: and how to Identify them.* By Dr. H. H. Allan. Pp. x + 188 + 31 plates. (Auckland, Christchurch, Melbourne and London: Whitcombe and Tombs, Ltd., n.d.). 6*s*. 6*d*.

THERE is perhaps no country in which the study of flora and vegetation has made greater progress in recent years than in New Zealand. This is not due to the larger number of workers engaged, nor is it because of a general increase in interest in the subject there, but rather to a marked re-orientation of viewpoint on the part of a small body of earnest investigators and the consequent opening up of new conceptions of the relationships of both species and communities. This is the result of two main factors: first, the application of the principle of succession to a study of the vegetation; and secondly, the recent visit of Dr. Lotsy to New Zealand. The three books before us reflect to different degrees this pronounced change in botanical outlook.

Botany in New Zealand, in spite of the few workers engaged in it, benefits greatly from several of its leading exponents being both ecologists and taxonomists. Investigators studying principally either the vegetation or flora of any part of the country have always the other division of the subject well in view. The advantages of such an outlook are shown in the great progress to which attention is directed above.

(1) The successional viewpoint in ecology did not find universal application at the time when the first edition of Dr. Cockayne's "Vegetation of New Zealand" was written (1913), but nevertheless is much in evidence in that book. In the second edition, however, it is the guiding principle throughout, and consequently the treatment becomes more connected. Naturally, an appearance of stability cannot be avoided everywhere; not enough is known of the development of the vegetation in many areas to deal with it entirely in a successional manner. It is in the descriptions of the forests that the greatest progress is evident, and here a really fundamental system of classification is being evolved. Much yet remains to be done, but the relationships between the sub-tropical and sub-antarctic rain forests and between the various divisions of the former are dealt with thoroughly. The importance, both ecologically and commercially, of the successional changes now in progress is obvious.

Before dealing with the "Vegetation of New Zealand" further, it is necessary to revert to the second factor mentioned above, namely, Dr. Lotsy's visit. Previous to this, the taxonomic traditions founded by J. D. Hooker and carried on faithfully by Kirk, Petrie, and particularly Cheeseman, had dominated New Zealand floristic botany. Dr. Cockayne had already in 1913 opened up several new lines of thought, but the value of these had been established only as the result of a continuous struggle against old viewpoints. The entry of Dr. Lotsy with his genetical outlook and precise specific concepts awakened into activity the dormant ideas of Dr. Cockayne and his co-workers, and suggested new explanations for many little understood and neglected observations. Some of Dr. Lotsy's concepts have been adopted wholeheartedly by New Zealand botanists, and have been employed in the discovery and elucidation of many peculiar features of the flora. Not the least important of these are the huge swarms of natural hybrids which have been detected throughout the

Dominion. The marshalling and classification of these, and the determination of their importance ecologically, is occupying the attention of several workers. When it is realised that two hundred and ninety different hybrid groups, the nature of most of which is based on substantial evidence, had been detected up to 1928, it will be seen that their presence is of considerable significance.

The study of epharmonic variation has also made great strides in New Zealand recently, and occupies a considerably larger proportion of the second edition of Cockayne's book than in the first. Bearing in mind Turesson's stimulating work on ecotypes, a great future can be predicted for studies along these lines in New Zealand.

An interesting feature of the book is the distinction from one another of what Cockayne terms *modified*, *indigenous-induced*, *exotic-induced*, and *artificial* communities. These terms are of definite value in a country in which aliens have become so important over large areas. Nevertheless, it is a striking fact that communities consisting entirely of native species, but never occurring in primeval New Zealand, have sprung up as a result of the indirect influence of man.

Dr. Cockayne's book can be strongly recommended to all interested in ecology or plant geography. It is full of original suggestions and novel conceptions and cannot fail to stimulate the reader. The format is an improvement on that of the earlier edition, the numerous subdivisions having been reduced considerably, while the elimination of the rather unsatisfactory text photographs has allowed of the inclusion of more plates at the end. The addition of another map enables the localities mentioned in the text to be inserted, and the boundaries of the botanical districts to be more accurately indicated.

(2) and (3) The other two books cited above may be looked upon primarily as adjuncts to the study of the vegetation, although they can be used separately. Both are designed as a means of identifying easily the woody plants occurring in the Dominion. Cockayne and Phillips Turner's "Trees of New Zealand" gives excellent photographs of all the important forest trees, with short descriptions and notes on distribution. There is also a brief account of the forests themselves and of the commercial timbers.

Dr. Allan's "New Zealand Trees and Shrubs" is a more remarkable work, since he succeeds in providing a means of identifying any woody plant without having resource in the first place to any but vegetative characters. The advantage of this to the working ecologist, who obviously has to deal in most communities with a majority of plants not in flower at any given time, is evident, and Dr. Allan deserves the thanks of all New Zealand students of vegetation for his carefully designed and thorough piece of work. The book is arranged on the dichotomous key system, there being a brief description of each species for confirmatory purposes. A number of useful photographs and text figures are included, among them being some illuminating hybrid series. A key to the genera, based on floral characters, is given at the end, but might have been more distinctly indicated by a special heading. Here, as in the "Vegetation of New Zealand", the importance of the hybrids, juvenile forms, and epharmones is stressed, while valuable hints are given to students.

Collectively, the three books constitute a trio which no student of the New Zealand flora and vegetation should be without, and indeed botanists in other countries may obtain useful suggestions for their own investigations from all three.

V. S. S.

British Rainfall and Weather Reports.

(1) *Meteorological Office: Air Ministry. British Rainfall, 1928: The Sixty-eighth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1928 as recorded by over 5000 Observers in Great Britain and Ireland.* Issued by the Authority of the Meteorological Committee. (M.O. 315.) Pp. xv+285. (London: H.M. Stationery Office, 1929.) 15*s.* net.

(2) *Meteorological Office: Air Ministry. The Weekly Weather Report for the period Feb. 26, 1928, to Mar. 2, 1929.* Vol. XLV. New Series. Issued by the authority of the Meteorological Committee. (M.O. 301.) Pp. 78. (London: H.M. Stationery Office, 1929.) 15*s.* net.

(1) THE sixty-eighth annual volume of the British Rainfall Organization summarises the records for 1928 from more than 5000 rain-gauges, the general method of treatment of this material being similar to that followed in the volume for 1927. It is satisfactory to note that there is an increase of 2 per cent in the number of records available for 1928 as compared with 1927, just as the number for 1927 exceeds that for 1926 by 2 per cent. Unfortunately, the greatest improvement in representation is for the counties of Surrey and Devon, both of which are already well represented, and not for any of those Scottish

and Irish counties where rainfall observers are very thinly distributed.

We learn from the summary of the year's rainfall at the beginning of this volume, that 1928 was the seventh year with a general rainfall equal to or greater than the 1881–1915 average, a run of wet years which, unless very exceptional weather is experienced during the rest of this year, will be ended by an exceptionally dry year, just as it was preceded by one (1921). A small coloured map shows very clearly the relation of this year's rainfall in different districts to the average. In general, the most elevated districts contributed most to the wet character of the year, while in England and Scotland considerable areas lying to the eastward of high ground showed a deficiency. This result was doubtless due to the fact that an unusually large proportion of the notably heavy falls was associated with cyclonic rains, which are very much assisted by the ascent of moist winds over hills and mountains. Regions with an excess of 50 per cent or more were to be found in south-west Scotland and north-west England; in Ireland no very obvious connexion between the excess of rainfall and the elevation of the land was apparent, the whole country showing a moderate excess.

Among the special articles may be noted a further valuable contribution by Mr. F. Hudleston on the effects of various kinds of wind-break upon the records of rain-gauges in exposed situations, and an article by Dr. J. Glasspoole on the rainfall of Norfolk.

(2) The Meteorological Office for fifty years published a weekly summary of meteorological observations made at a number of stations distributed throughout the British Isles, but by the autumn of 1926 the Meteorological Committee had under consideration the revision of the form of the report and the substitution for it of an annual publication in which the unit of time is still the week. The last issue of the old series covered the week ending on Feb. 25, 1928, and the first volume of the new series, which has recently been received, deals with the period Feb. 26, 1928–Mar. 2, 1929.

The old weekly report appeared so soon after the occurrence of the weather which it summarised that the latter was still more or less clearly within the memory of the reader; with the new report this will seldom be the case. In making such a change the Meteorological Committee has clearly taken the view that the weather reports issued by the B.B.C., together with the daily issues of the Meteorological Office, are sufficient to meet the needs of those who take an interest in the current weather as so much 'news', and that for the majority of statisticians, to whom the weekly averages of past years are often of equal importance with those of the current year, the most important matter is that of presenting the statistical material in the most convenient possible form. In that respect the new issue is immensely superior to the old.

There are five stations to each of the eleven districts into which the mainland of Great Britain and Ireland is divided, and for each station there is a single table, occupying a single page, which summarises the temperature, rainfall, and sunshine for each week of the year at that station. These tables enable the general character of a year in any part of the country to be determined almost at a glance. A still broader survey of the year's weather is given by four pages summarising the same information for the different districts, in the form of departures from the 'normal' for the district. In this connexion an improvement has been introduced in the technical method by which a normal is calculated, whereby the cessation of the record from a particular station, and its substitution by another of different climatic character, does not make any sensible break in the continuity of the 'district values' of temperature, rainfall, and sunshine.

On the whole, the new form of the "Weekly Weather Report" should be much better suited than the old to the needs of those research workers who wish to determine the effect of the weather upon such variables as, for example, crop-yield, the incidence of particular diseases, or the death-rate.

Archæology of Malta.

Excavations in Malta. By M. A. Murray. Part 1. With a Chapter by G. Caton-Thompson. Pp. iii +49+21 plates. Part 2. With a Chapter by G. Caton-Thompson. Pp. iii+43+33 plates. Part 3. With a Chapter by C. Ainsworth Mitchell and Thomas J. Ward. Pp. iv+38+35 plates. (London: Bernard Quaritch, Ltd., 1923–25–29.) 3 Parts, 15*s*. net.

THE vast megalithic buildings with their pillars and sculptures scattered in such profusion on the barren little island of Malta present a most fascinating problem for the archæologist. Miss M. A. Murray is to be congratulated on discovering and scientifically exploring and describing yet another of the puzzling structures during three years of most

careful and accurate excavation. Borg en Nadur, as her site is named, proves to represent a typologically early form of those 'temples' already known at Hagiar Kim, Hal Tarxien, and elsewhere in the island. It consists of two pairs of apses linked by a short passage and leading to a semicircular sanctuary, the whole opening on to a large enclosed court.

The pottery that constituted the bulk of the finds is divisible between the two classes termed by Prof. Zammit 'neolithic' and 'bronze age' respectively, but no stratigraphical separation, such as was observed at Hal Tarxien, was traceable here. In addition to her own sherds, reproduced most faithfully both as photographs and line drawings, Miss Murray collects and publishes an illustrative series of the 'bronze age' wares from other sites. When thus viewed as a whole, it is easy to see how closely this group of wares is allied by form and ornament to a class of pottery distinctive of the latest bronze age in Italy and Sicily. This phase of Maltese culture being thus correlated with the sub-Mycenean epoch in the Ægean, Sir Arthur Evans's arguments for a Middle Minoan date as the upper limit of the preceding 'neolithic' phase are materially strengthened.

In addition to broken vases, Miss Murray found a number of anchor-shaped objects of clay to which only Bahria offers parallels in the island. She points out that both sites are situated where votive offerings by mariners might be expected, but if the clay objects are really such votive imitations of anchors, they will be the earliest evidence of the use of that device in the Mediterranean.

While Miss Murray was working at Borg en Nadur, Miss Caton-Thompson was conducting scientific excavations in the cave of Ghar Dalam. As is well known, this cave contains a deposit of the bones of extinct pachyderms; and the discovery in it of a human tooth with the roots fused in a manner generally peculiar to men of the Neanderthal species led to the theory of a Mousterian occupation at the time when a land-bridge still connected Europe and Africa. The breccia of hippopotamus bones has even been interpreted as a palæolithic kitchen-midden. The most minute investigations, however, failed to produce a single implement attributable to palæolithic times, though 'bronze age' and 'neolithic' remains were abundant in the upper layers. Hence the pretty theories so vividly illustrated in a certain popular magazine a few years ago have to be abandoned; for Miss Caton-Thompson shows that the negative evidence is really conclusive. V. G. C.

Our Bookshelf.

Contributions to the Principles of Morphology. By William Bernard Crow. (Thesis approved for the Degree of Doctor of Science in the University of London.) Pp. viii + 94. London: Kegan Paul and Co., Ltd., 1929.) 5*s*. net.

THIS small volume focuses attention upon the principles underlying the branch of science which is the most neglected of all at the present time, anatomy. It is true that professors of anatomy are attached to the medical schools of Great Britain and other countries; but most of their work is concerned with matters which bear a similar relation to anatomy that a knowledge of the sites and situations of the bottles on the shelves of a chemical laboratory bears to chemistry. Morphology, as Dr. Crow rightly observes, has few practical applications except in medicine and psychology. These are not dealt with in his book. Therein is presented "the analysis of the principles of a pure science".

Although the practical applications of morphology are few, those which do exist are of such importance that they have obscured the science itself, and its principles too often are left to the whim of the individual for enunciation. Dr. Crow fears that his treatment, avoiding as it does the enormously detailed field of applications, is arid. It is, just as a statement of the bare principles of dynamics unsupported by instances and applications would be arid. But it is of great interest, nevertheless, because it affords a clear presentation of the real difference between physico-chemical materialism, which has no place for form and relationship in its concept of Nature, and morphology, for which this form, organisation, or arrangement, constitutes an individual. Such forms may be compared and measured; but resemblances are established rather than identities and equalities. Nevertheless, homology leads to seriation, and classification to theories of affinity. Morphology lives in its instances, not only in its principles, and theories of affinity need not be its final aim. Modern physics should suffice to deny the facile claim that a structural approach to biological laws is unfruitful.

The Savage as he really Is. By J. H. Driberg. (Routledge Introductions to Modern Knowledge, No. 3.) Pp. ii + 78. (London: George Routledge and Sons, Ltd., 1929.) 6*d*. net.

THE small size and cheap price of Mr. Driberg's booklet are in inverse ratio to its worth. He does not deal with the character of the savage, but merely with his capacity to think, and comes to the conclusion that they think as we do, argue, and make deductions from ascertained premises. That these deductions are often false is immaterial; they prove to be rational even when their customs appear most irrational.

Mr. Driberg bases his conclusions on a brief survey of the environment, significance of the clan, magic, medicine, and language of various African peoples, of most of whom he has intimate

personal knowledge. He indicates that there are variations in mental ability in savage communities, but he has not tried to describe the intellectual type of mind; but it is probably true to say that the savage is more disposed to the concrete than we are, though this does not exclude abstract thought and speculation. "Does it matter to us, however, how the savage thinks or behaves? . . . Only by a true appreciation of primitive ideas, only when we know how they think and why they behave as they do, can we govern them to their best advantage and our own. . . . The savage as he really is is not an academic problem, but a very concrete and urgent reality." Everyone who has any dealings with Africans, or indeed with any other primitive peoples, should buy this suggestive and practical little book. A. C. H.

Logarithmetica Britannica: being a Standard Table of Logarithms to Twenty Decimal Places. By Dr. Alexander John Thompson. Part 4: *Numbers 40,000 to 50,000.* (Tracts for Computers, No. 16.) Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the "Arithmetica Logarithmica, 1624". Pp. vi + 100. (Cambridge: At the University Press, 1929.) 15*s.* net.

PART IV. of this monumental work, the third to be published, gives the logarithms of numbers between 40,000 and 50,000. These were obtained by adding the logarithm of 0·5 to the logarithms of all the even numbers between 80,000 and 100,000 which have already appeared in Parts VIII. and IX. The present part contains an analysis of the errors for the numbers between 90,000 and 100,000 in Briggs' "Arithmetica Logarithmica" published in 1624. It is interesting to note that nearly all the errors are in the last places of the logarithms. An inspection of the analysis shows that the first group of six figures in Briggs's 15-place logarithms contains errors in 9 instances, the second group of five figures in 3 instances, the remaining errors being in the last group of four figures.

The printing and arrangement continue to deserve the highest praise. L. M. M.-T.

Taxation in the Modern State. By Prof. Alzada Comstock. (Longmans' Economic Series.) Pp. viii + 240. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THERE is probably no subject more appealing to men than one which affects their pockets; the eternal ego is the centre of attraction, and consequently Dr. Comstock's book will create a responsive echo. In most countries taxation is now a very different matter from the levies made by way of Customs and Excise from early times down to a period not really remote, but seemingly far distant on account of the world upheaval. This has entailed a complicated and scientific readjustment of burdens, variously met by various nations. Adam Smith formulated four rules of taxation: Ability to pay, certainty of incidence, convenience in form, and economy in levy. The burden upon the public is heavy (nowhere so heavy as in Great Britain); Germany has issued from the fiscal turmoil in better condition than the other countries, but this was due to the confiscation of capital during lifetime, whereas elsewhere (particularly in England) such confiscation is reserved until death supervenes, and hence income suffers. Passing over Adolph Wagner's socio-political theory, attention may be directed to Prof. Pigou's view that 'ability to pay' has been to-day converted into 'sacrifice', though without 'equality of sacrifice'; progressive income taxation, however, seems to connote the idea of parity. P. L. M.

Auguste Comte, Thinker and Lover. By Jane M. Style. Pp. v + 206 + 1 plate. (London: Kegan Paul and Co., Ltd., 1928.) 5*s.* net.

POSITIVISM has been defined as the "system of philosophy which limits itself to the study of phenomena and the laws which regulate them". Comte, who built up this system, declared that the knowledge of phenomena is relative, not absolute; he anticipated Einstein by a century in the promulgation of the doctrine of relativity; "Tout est relatif; voilà la seule chose absolue". The great French philosopher, the founder of the science of sociology, was one who practised even whilst he preached, and he had the good fortune to be widely appreciated during his lifetime, which is not invariably the experience of pioneers. He (like Cæsar, Gregory, and Omar Khayyám) also had views as to the reform of the calendar. In Comte's case it may truly be said that the good he did survived him, though it is the fashion of the day to consider him a 'back number'; or shall we say, a backwater? He proved, in his own life, how "That men may rise on stepping-stones Of their dead selves to higher things". The biographer has evidently regarded her labour as one of love; and though her sentences are too often breathless and some of her sentiments more than disputable, yet her book is eminently readable and will attract wide attention.

The Principles of Systematic Entomology. By Prof. G. F. Ferris. (Stanford University Publications, University Series: Biological Sciences, Vol. 5, No. 3.) Pp. 169. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1928.) 12*s.* 6*d.* net.

WE can commend this book to systematists in general, and to entomologists in particular. It discusses in a critical way existing methods of systematic entomology with suggestions for their improvement. The importance of taxonomy to-day can scarcely be overrated, and it is imperative that if work of this character is to stand the test of time, and not merely add to existing confusion, new species should be accurately and sufficiently diagnosed and, furthermore, adequately illustrated. As Dr. Ferris remarks—to add to the number of named species has too often assumed an undue degree of importance: too often it has nothing to do with any actual increase in knowledge; and too

often it merely adds more inadequately described species to the already long list of such encumbrances. We feel sure that if the contents of this book be taken seriously and the more potent of the suggestions acted upon, some of those who describe new species of insects will return to their work with a higher ideal, with more refined technique, and, perhaps, with a greater sense of responsibility.

Scoliodon (*the Common Shark of the Indian Seas*). By E. Muthammah Thillayampalam. (The Indian Zoological Memoirs on Indian Animal Types, 2.) Pp. xi + 116 (10 plates). (Lucknow: The University, 1928.) 2.8 rupees; 3*s*. 6*d*.

THERE are few publications for students dealing in detail with the structure and development of common Indian animals, and a committee of Indian zoologists is now issuing a series of memoirs to rectify this. Prof. Bahl wrote the first on the earthworm, and set a good standard which is well maintained in the present publication. The detailed study of types is necessary to teach accurate observation, and we trust that these memoirs will become a regular feature of the teaching of zoology in India. Surely the bibliography should be complete or consist merely of a few references to publications generally available in universities. We prefer, where possible, names or letters on drawings in preference to numbers, which few students will struggle to follow throughout. Yellow should never be used on any figure intended to be studied by artificial light.

Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus. By Dr. William Harvey. With an English translation and Annotations by Prof. Chauncey D. Leake. (Tercentennial edition.) Pp. vii + 74 + 154 + 8 plates. (London: Baillière, Tindall and Cox, 1928.) 16*s*. net.

THIS fine volume contains a facsimile of the original Latin edition published by Harvey at the age of fifty in 1628, followed by a free translation by Prof. Leake, who holds the chair of pharmacology in the University of California. We learn from the postscript that this is the third attempt to render Harvey's classic into current English idiom, the first being the work of an anonymous author in 1653, and the second the stilted and involved version of Dr. Robert Willis, who made a translation for the Sydenham Society in 1847.

Prof. Leake has added many instructive footnotes to his translation in order to illustrate the relation of Harvey's work to our modern knowledge of cardiac function.

The book contains two portraits of Harvey and a facsimile of his first note on the circulation made in 1616.

An Introduction to Biophysics. By Prof. David Burns. Second edition. Pp. xix + 580. (London: J. and A. Churchill, 1929.) 25*s*. net.

THE second edition of this text-book has been considerably enlarged, revised, and in places re-written. A new chapter on soaps and emulsions has been added; the sections on surface tension, general receptors, ear, eye, voice, and limb movements have been extensively revised. The illustrative experiments which form a separate section have also been largely rewritten as the result of several years' experience in the teaching of physiology.

For those who are unacquainted with Prof. Burns's work, it may be described as physical physiology or physiology from the point of view of mechanics and physical chemistry. Thus it includes, although in greater detail, much that is to be found in the standard text-books on this subject, but the problems are approached at a different angle. Both from the theoretical and the practical aspects the book will be of value to teachers and to advanced students, since it provides under a single cover a quantity of information which can only be found scattered through the literature. The illustrative experiments provide a good introduction to physical chemistry.

Rhythmische Phänomene der Erdoberfläche. Von Henning Kaufmann. Pp. v + 347. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 14 gold marks.

ON the surface of contact of two different media, such as air and water or water and sand, various rhythmic forms are produced when there is relative movement. The forms vary widely in kind and order of magnitude, and include sand dunes, ripple-marks, and river meanders. This book is devoted to a systematic account of the phenomena involved and the morphological features produced, and is useful as a compilation of observations and hypotheses, and as a bibliography of the subject. Unfortunately the physical treatment is weak and no mathematical discussion is presented. Although the book does not add any original contribution to the theoretical aspects of the rhythmic and periodic phenomena of geology, it will nevertheless serve a valuable purpose in providing geologists, geographers, and engineers with a most convenient summary of what is already known in a somewhat neglected field of investigation. The author deserves our gratitude, if only for his enterprise in tidying up a very scattered subject.

Wave Mechanics: being one Aspect of the New Quantum Theory. By Dr. H. T. Flint. (Methuen's Monographs on Physical Subjects.) Pp. ix + 117. (London: Methuen and Co., Ltd., 1929.) 3*s*. 6*d*. net.

THIS little book fills a definite gap in the literature of wave mechanics in that it gives in small compass a clear mathematical account of the variation principles of dynamics and optics, the analogy which points the way to mechanical waves, the nature of the problem and its solution. This may seem an ambitious task, but by confining himself to the simplest cases and by adopting a proper mathematical formulation, Dr. H. T. Flint has succeeded in producing an essay which is exact and intelligible. The bibliography on p. 113 reveals the identity of a person whose name is spelt Shroedinger in the preface and throughout the book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Early Rhodesian Mining and Zimbabwe.

MISS CATON-THOMPSON'S clear statement (NATURE, Oct. 19, p. 619) of her important contributions to the early history of Rhodesia, raises again the problem of the relations of the ruins and mining. Any one of four solutions may be possible: (1) Both ruins and mines may be prehistoric; (2) or both medieval; (3) or the ruins may be relatively modern and Bantu, while the mining may be exotic, may have been begun two or three millenniums B.C. and have been continued until Roman times, and to a small extent by the Arabs; or (4) some of the buildings may be medieval and rough copies of the ancient architecture—for it was the claim that some of the walls which MacIver proved to be medieval had been previously identified as such by South African archæologists, owing to the crudeness of the work, that rendered his results unconvincing.

Miss Caton-Thompson's article deals only with the ruins; but her statement that "it is inconceivable to me . . . how a theory of Semitic origin could ever have been started", and some remarks in the leading article in NATURE of Oct. 19, both imply that her excavations disprove the extraneous origin of the mining.

The view that the early gold mining of Rhodesia is medieval and Bantu is faced by difficulties which make students of mining history hesitate to accept it. Mr. Hays Hammond recognised at the opening of the Rhodesian fields that the amount of gold won from them was so immense that it must have been the main source of gold in early times. He estimated in 1894 that the amount was undoubtedly "millions of pounds sterling worth of gold". By 1897 more of the ancient workings were known, and Telford Edwards estimated their yield as £75,000,000. Further ancient workings have been discovered since then, so that this amount must be increased. According to some estimates the ancient miners removed 100,000,000 tons of ore.

Where did all this gold go? There is no evidence of its use in South Africa. The amount exported in medieval times to Arabia must have been relatively small. Which lucky country received it? Ancient Egypt and Chaldea imported large quantities of gold; and the only known early gold workings adequate for their supply are in South Africa. Tibet and southern Siberia must be considered as a possible source from traditions; but there is no evidence of extensive ancient gold workings in either. Mr. L. Woolley ("Sumerians", 1928, p. 116) quotes the bill of lading of a vessel that returned to the Persian Gulf in the year 2048 B.C., after a two years' absence, with gold, ivory, copper ore, etc. This record shows that some of the gold of Ur came from far to the south, and the Mysore gold field, the only southern alternative to Rhodesia, is improbable.

In addition to the inferences from the distribution of early gold mining and the nature of the Rhodesian workings, there is evidence of pre-medieval mining in Rhodesia, such as a Roman coin found in a shaft 70 feet deep near Umtali; beads referred to Ptolemaic Egypt and pre-medieval India; the use of ingot moulds of the X-shaped pattern used by the Phœnicians in Cornwall; soapstone birds similar to those used in Assyria and in the gold and turquoise mines of Egypt; a knobbed cylinder compared by Hogarth to one from Cyprus; the Groot Schur platter with the signs of the zodiac; inscriptions that have been identified as proto-Arabic and Semitic characters. Miss Caton-Thompson may regard these objects as all typically Bantu. But Sir H. H. Johnston, no mean authority on Bantu ethnology, declared (*Geog. Jour.*, vol. 37, p. 340) that except for "an incursion of a Semitic race of teachers I cannot otherwise explain the gold-mining, the soapstone birds, the phalli, and the several other features in these remains which are so utterly unlike anything that has ever been made by any race of Bantu negroes".

The leading article in NATURE refers to "this unique efflorescence of Bantu culture". Negative evidence has led some archæologists to deny the presence of Phœnicians in Britain. I understand that, with the exception of the tin ingot dredged in Falmouth Harbour, not a single Phœnician or Greek relic has been found in Cornwall. Yet the balance of opinion is still overwhelmingly in favour of the Cornish tin mining having been established under Phœnician influence.

The view that Zimbabwe may have been a medieval archæological museum where the Bantu collected the soapstone birds and ingot moulds of a then prehistoric people, and made crude copies of their own, is, of course, possible. But until some other explanations be offered of where the ancient Egyptians and Sumerians obtained their gold, where the gold from Rhodesia went, of the use by the early gold and copper smelters of Rhodesia of the Phœnician pattern of ingot mould, and of the resemblance of various objects to those of south-western Asia, the students of ancient mining will probably retain the belief that the early mining in South Africa was organised by foreigners who shipped the gold and copper to the Red Sea and Persian Gulf.

A note in NATURE of Sept. 28, 1928 (p. 493), summarises a paper by Dr. P. A. Wagner, which was read recently in South Africa, in which he extends the arguments for extensive mining in Northern and Southern Rhodesia, under alien influence, in times that were long pre-medieval. J. W. GREGORY.

The Late Palæozoic Glaciation.

PROF. SCHUCHERT, in his recent paper on the late Palæozoic ice age (*Bulletin of the Geological Society of America*, vol. 39, pp. 769-886), has strenuously fought for the view that the ice age is not older than Middle Permian. I have read with interest Dr. H. Dighton Thomas's article in NATURE (June 22, 1929, p. 946), and both I and, I think, all my colleagues of the Geological Survey of India, are in agreement with Dr. Thomas's views. It appears quite impossible to regard the whole of the Productus Limestone of the Salt Range as belonging to the Upper Permian only. I prefer to regard the Upper Productus Limestone of the Salt Range (Chidru beds) as Upper Permian, the Middle Productus Limestone with *Xenaspis carbonaria* as of Middle Permian age, and the Lower Productus Limestone with *Spirifer Marcoui* as Lower Permian. With the Middle Productus Limestone may be correlated, according to C. Diener, the bulk of the Zewan beds of Kashmir, and the fauna of exotic block No. 1 of Chitichun (*Pal. Ind.*, New Ser., vol. 5, Mem. 2, p. 110). Diener places the *Gangamopteris* horizon of Kashmir in the Lower Permian or Artinskian (*ibid.* p. 111).

In 1928, Dr. F. R. C. Reed and I visited Warcha Salt Mine in the Salt Range in order to examine the succession from the Glacial Boulder Bed upwards through the Permian to the Trias. The results of our

work are being published in the *Records of the Geological Survey of India*, and will shortly appear; meanwhile, it may be of interest to state such results as throw light upon the age of the Boulder Bed. In ascending order the succession in the Jansukh nullah at Warcha is: 1. Boulder Bed, 6 inches to 2 feet. 2. Green sandstones with coaly laminæ, 38 feet. 3. Purple and white pebbly sandstones, 277 feet. 4. Lavender clays (see *Mem. Geol. Surv. Ind.*, vol. 14, p. 90), 42 feet. 5. Carbonaceous sandstone, 27 feet. 6. *Fusulina* Limestone (lowest bed of Productus Limestone). This gives a thickness of 386 feet from the base of the Boulder Bed to the first bed of *Fusulina* Limestone.

In the adjoining nullah (Jarhanwala nullah) there is a very fine section of Productus Limestone. The sandy beds with the Boulder Bed at their base here also underlie the Productus Limestone. Their thickness could not be measured with the same accuracy as in the Jansukh nullah, but we were able to prove by measurement that the thickness was more than 290 feet. The section through the sandy basal beds is, however, obscured by screes and badly exposed. We were able, however, to measure the Productus Limestone with some success, especially its lower portion. The lower 225 feet of the Productus Limestone can be subdivided into small lithological units owing to the alternation of limestone with shale and sandstone. The higher horizons of the Productus Limestone are much more homogeneous. This lower division, 225 feet thick, of the Productus Limestone at Warcha is of exceptional interest, because about 40 feet from the top we found a carbonaceous bed with plant fossils (*Gangamopteris*, *Glossopteris*, and *Annularia*). If these beds are Lower Permian, the *Gangamopteris* horizon would correspond very closely with the *Gangamopteris* horizon of Kashmir (accepting Diener's age for the latter).

It is to be noted that the Glacial Boulder Bed is well below the *Gangamopteris* horizon, some 500 feet of strata intervening. From its stratigraphical position one would be inclined to place it in an older stage than that of the Lower Productus Limestone, and if the latter is Artinskian the Boulder Bed may reasonably be suspected to be Uralian in age. I may here note that Dr. F. R. C. Reed and I are of opinion that the lower beds of the Productus Limestone in the Jarhanwala at Warcha are to be correlated with the Lower Productus Limestone of other sections in the Salt Range.

The progress of the geological survey of Hazara by D. N. Wadia has indicated the Permian age of the Infra-Trias Limestone group of Middlemiss (see *Mem. Geol. Surv. Ind.*, vol. 26). Middlemiss had indicated the probable correlation with the Talchir Boulder Bed of the Tanakki Boulder Conglomerate which underlies the Infra-Trias Limestone south of Abbottabad. D. N. Wadia has recently strengthened this hypothesis by finding ice-scratched boulders in the Tanakki Conglomerate. Wadia also finds that the Infra-Trias Limestone in the Kaghan Valley in North Hazara is underlain by Agglomeratic Slate with interbedded conglomerates. He regards the Agglomeratic Slate as homotaxial with the Tanakki Conglomerate. If this be so, then the age of the Conglomerate is perhaps not later than Upper Carboniferous. Middlemiss and Bion ("Fauna of the Agglomeratic Slate Series of Kashmir", *Pal. Ind.*, New Ser., vol. 12) ascribe a middle to upper Carboniferous age to the Agglomeratic Slate. Middlemiss had previously (*Rec. Geol. Surv. Ind.*, vol. 40, p. 233) suggested that the Agglomeratic Slate was of similar age to the Talchir Boulder Bed.

From whatever side the question is viewed, it does not appear that the Indian sections give any support to Prof. Schuchert's theory. Further, his account of the Gondwanas of the Peninsula is not free from error. Thus, on page 851 of his paper, he lists *Gondwanosaurus* as coming from the Mahadeva-Maleri series, which, he states, is Upper Trias. *Gondwanosaurus* is of course Permian. On the same page he lists *Gangamopteris* and *Dancœopsis hughesi* as belonging to the Middle Gondwana. *Gangamopteris* is of course only found in the Talchir and Damuda series of the Lower Gondwana (Upper Carboniferous to Permian), while *Dancœopsis hughesi* is believed by all palæobotanists to be of Upper Trias or Rhætic age, and not Lower Trias to Upper Permian as Schuchert suggests. *Dancœopsis hughesi* is found at Parsora in South Rewah, and the beds from which it comes are very close in age to the neighbouring Tiki beds with Upper Triassic reptilian and amphibian fauna.

G. DE P. COTTER
(Palæontologist, Geological Survey of India).
27 Chowringhee, Calcutta.

New Phenonema in a Sounding Dust Tube.

WITH the view of making accurate measurements of the velocity of sound, and hence of the ratio of the two principal specific heats of gases, we have been studying the formation of dust figures in a sounding tube. Instead of using a stroked rod to produce the vibrations of known frequency, as Kundt did in the form of experiment known by his name, we employ a telephone diaphragm (actually a loud-speaker unit) excited by a current of approximately pure sine-wave form, which is produced by a suitable valve circuit. The frequency of the vibration is then varied until one of the resonant frequencies of the tube is reached, when the dust phenomena are produced with great distinctness and can be studied at leisure.

Many features of the dust movements which have apparently hitherto escaped observation have been

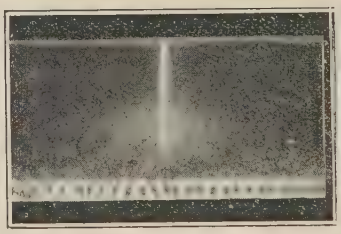

FIG. 1.

FIG. 2.

observed with this technique. One of the most important is the formation of clearly defined discs of dust particles, which extend across the tube, like barriers, *at the antinodes*. These discs are of surprising sharpness, being, in favourable cases, not more than a millimetre thick, while the crosswire of a reading telescope can be set on the central plane of a disc to within a tenth of a millimetre. The formation of these discs will be discussed in a forthcoming publication, but their definiteness, to which we wish to direct attention, is clearly shown in the accompanying photographs (Figs. 1 and 2), Fig. 1 showing a disc as seen from a horizontal direction normal to the axis of a tube, and Fig. 2 a similar disc as seen obliquely and from somewhat above the tube. Fig. 2 also shows the sharpness with which the 'ridges' are developed in our experiments, which have sufficed to convince us that the explanation generally given of the formation of these ridges is untenable.

Measurements of the separation of the antinodal discs permit determinations of the velocity of sound to be made with much greater precision than can be secured by the usual Kundt's tube method. Pre-

liminary experiments with air have shown that the velocity can be easily determined with an accuracy of 1 part in 300, probably 1 part in 1000. The frequency of the vibration is measured by sending the current through the wire of a string galvanometer and recording the movement of the wire photographically, with the record of a standard tuning fork as a comparison. The accurate running of the fork is at present fixing the limit of accuracy.

Other observations are concerned with the behaviour of very small particles which take up practically the full amplitude of the air vibration, and appear as little lines of light when strongly illuminated. The lines, or 'needles', as we have called them, have a length of some millimetres when the tube is run on the fundamental note with one end open. They have also been observed, if in a less developed form, by M. Z. Carrière, and described by him in a paper in the *Journal de Physique* for May 1929, a note of which in the research items of NATURE of Sept. 28 directed our attention to it. The independence of our observations is established by the fact that we showed these needles publicly in a demonstration at the Royal Institution on Friday evening, Mar. 22, before M. Carrière's paper was published. Whereas M. Carrière records that he failed to photograph the needles, we have succeeded in obtaining very definite photographic records, of which Fig. 3 is an example, which shows both larger and smaller particles, the larger ones not taking up the full amplitude of the air vibration. The effect of a sideways drift of some of the particles, which develops a sinusoidal form for the path, is also clearly visible. Measurement of the length of the finest needles seems likely to lead to interesting results.

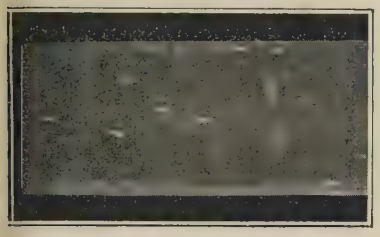

FIG. 3.

E. N. DA C. ANDRADE.
S. K. LEWER.

Physics Laboratory,
University College,
London, W.C.1, Oct. 11.

Dew: Does it Rise or Fall?

DR. SIMPSON (NATURE, Oct. 12, p. 578) has misstated my view. It is clear that when I wrote real dew rises as vapour from the ground I referred to the source of the dew and not to the dew itself, and therefore regarded as vapour "it may be said" to rise. It was therefore unnecessary for Dr. Simpson to point out that dew is water and not water vapour. I have given some time to the study of dew, and though Dr. Simpson offers the generally accepted explanation of its formation, it is curious to observe how capriciously dew appears to deposit, some objects remaining quite dry on a dewy night, whilst others in close contact are covered with moisture.

In general the phenomena can be readily accounted for by vapour from one or other of the sources mentioned in my former letter.

Dr. Simpson says we have no word to describe water condensed in the air. In a paper published in the *Quart. Jour. Royal Meteorological Soc.*, vol. 30, No. 131, I gave it the name of *false dew*, which seems to me to answer the purpose.

J. B. COHEN.
1 North Grange Mount,
Headingley, Leeds.

DR. SIMPSON pronounces that it does neither (NATURE, Oct. 12, p. 578), and there is only one point that I find a difficulty in following in his very clear interpretation of the formation of dew.

"The dew", he says, "is nowhere" until it appears on the surface of objects whereof the temperature has fallen below that of the surrounding air. If that be the only process in the formation of dew, how is hoar frost to be understood? For, says Dr. Simpson, "hoar frost is true frozen dew". Are we to assume (it would be difficult to prove) that the surface temperature of leaves and other objects had fallen below the dew point before the surrounding air fell below the freezing point? Or does a lower temperature of the air cause the moisture in it to be condensed in the form of hoar?

Dew, whether liquid or frozen, lies almost wholly on the upper surface of leaves, etc. It must, therefore, be chiefly derived from the air above such objects, and to that limited extent perhaps the poet may be justified in declaring that—

"Maxwellton braes are bonny
Where early fa's the dew".

HERBERT MAXWELL.

Monreith, Whauphill,
Wigtownshire.

I AM sorry that Dr. Cohen thinks I misstated his views: but after comparing his letter (NATURE, Sept. 28, p. 482) and my letter (NATURE, Oct. 12, p. 578) very carefully I cannot see his point. I only referred to Dr. Cohen twice in my letter: in the first case I wrote: "Dr. J. B. Cohen . . . says it does both", while his actual words were: "I think it may be said to do both"; in the second case I wrote: "Both Sir Herbert Maxwell and Dr. Cohen speak of the water vapour first condensing in the air before appearing as dew"; Dr. Cohen actually wrote: "The cold air tends to cool the objects with which it is in contact and the water vapour present in the warmer air is thereby condensed. Mist over water and marshy ground is formed in this way and this dew may therefore be said to fall". I wish to be helpful in this correspondence, and if Dr. Cohen will be good enough to say in what particular he cannot accept my explanation of dew formation, I will do my best to elucidate the point.

From Sir Herbert Maxwell's letter and a personal letter I have received from Dr. Leonard Hawkes, it appears that my phrase "hoar frost is true frozen dew" has led to misconception. Taken alone it might be read to mean "hoar frost is dew which has been frozen", but when read as part of the sentence in which it appears this reading should be impossible. Still it would have been better to have avoided the ambiguous wording. Sir Herbert Maxwell's difficulty, however, does not appear to be concerned entirely with my wording. I should, therefore, like to amplify my previous letter.

In the process of the formation of dew or hoar frost we are not directly concerned with the temperature of the air; the only two temperatures which come into play are the temperature of the cooling body (say a blade of grass, to fix the attention) and the temperature of the dew point of the air. When the temperature of the blade of grass falls below the dew point owing to radiation, condensation takes place on its surface, and if the dew point is below the freezing point the product of condensation is ice—even though the air temperature is above the freezing point, as it may well be. Ice formed in this way is hoar frost.

When mist forms in air below the freezing point, the mist particles remain liquid, but super-cooled,

until they strike an object, when they solidify on contact. Thus bodies exposed to mist or fog at low temperatures become covered with a coating of light fluffy ice to which we give the name of 'rime'. In certain conditions of thin mist hoar frost and rime may both be formed at the same time.

G. C. SIMPSON.

Meteorological Office,
Adastral House, Kingsway,
London, W.C.2.

Empirical Factors in Weather Forecasting.

THE Meteorological Office always welcomes friendly and constructive criticism, and therefore it gives me much pleasure to reply to the points raised by Mr. Wilfred Trotter in his letter published in NATURE of Oct. 19. Mr. Trotter's main indictment is that modern British forecasts prepared on synoptic charts take too much account of the pressure systems shown on those charts and too little of that general tendency for persistence of weather which sometimes seems to cause fine weather to continue for a long unbroken spell with little regard to the pressure distribution. It would be idle to deny that there may be some truth in this charge, but perhaps I may point out some of the difficulties with which the forecaster is faced. Let us take as an example a case which was fairly common during last summer, when a trough of low pressure over Ireland, stretching down from an Icelandic depression, is moving eastward across the British Isles and probably already giving some rain in Ireland. The question to be answered is, Will this rain spread to the south and south-east of England? The forecaster knows from his experience that in normal circumstances it will generally do so. In the particular type of weather which we are discussing he also knows that the past month or past few months have been abnormally dry. There are these two conflicting elements to be balanced. If he leaves out rain and it comes, he fails in what to many people is the most important factor of his forecast. He decides that he cannot take this risk with no better grounds for the omission than the somewhat nebulous one that the summer has so far happened to be abnormally dry. He therefore indicates the probability of some rain; when he comes to the office the next day and reviews the situation, he may wish that he had taken the risk and left out the reference to rain. It is easy to be wise after the event. It must be remembered that, even in a dry summer like the past, there have been days when troughs of low pressure have given rain in the south of England, so that if the forecaster had omitted to mention it on every occasion, he would in some cases have been wrong, and badly wrong.

There is a further point. The Meteorological Office has to forecast for the whole of the British Isles, and it frequently happens that drought in one part of the country coincides with excessive rain in another part. We have been taken to task already this summer for not making enough mention of heavy rains which fell in the West Highlands of Scotland. The forecaster, therefore, who is looking at the whole of the country may not have the dryness of the season impressed upon him quite so strongly as members of the public who see the weather in their own locality only, and from the nature of the case take little account of that in other areas. We have been aware of this tendency to forecast rain more frequently than the event proves to be necessary in dry spells for many years, and if we have failed to benefit by experience, this is due more to the difficulty which I have tried to indicate above than to ignorance of the facts. The cure will be found in more science, not less. When we really understand the workings of the atmosphere and have enough upper air observations to tell us what is happening at the time, we shall know that the particular trough which is approaching cannot bring rain; but that time has not arrived yet.

One further criticism is made by Mr. Trotter, and that is with regard to the forecasting of summer thunderstorms, his charge being that too little account is taken of the time of year and that thunderstorms are forecast as confidently in the latter part of August, or even in September, as in the middle of July when the thunderstorm season is at its height. The forecasting of thunderstorms is perhaps the branch into which more scientific method has been introduced than into any other branch of forecasting, and much account is now taken of whether the upper air conditions, as shown by aeroplane ascents, are stable or unstable. Nevertheless, these observations are not always available when required, and then the older methods of forecasting by pressure distribution and surface temperature have to be used exclusively.

I have not statistics available to show whether Mr. Trotter is right in thinking that the trustworthiness of the forecasts of thunder declines steadily throughout August. The average number of days of thunder at Kew Observatory in August is equal to that in July, and higher than in any other month of the year, though the September figures show a sharp drop. Recent criticisms of our forecasts have suggested that we forecast thunder too often throughout the whole summer, and I believe that this is largely due to the fact that any individual observer is concerned only with the thunder in his immediate vicinity, whereas our forecasts cover a whole district. If a thunderstorm is likely in any part of that district, we do not feel justified in omitting it from the forecast. The number of days in an average summer when thunder is reported at a few isolated places but by no means generally over a district, is very considerable.

J. S. DINES.

Meteorological Office,
Adastral House, Kingsway,
London, W.C.2, Oct. 25.

The Motion of a Lorentz Electron as a Wave Phenomenon.

I HAVE been able to express the equation representing the uniform motion of the surface of a Lorentz electron in a form which strongly suggests that the 'parcel' or particle aspect of the phenomenon may be associated with the interference of two waves. Thus, if (x, y, z) are Cartesian co-ordinates relative to a material observer and t is his proper time, the motion of the electron's surface is represented by

$$\frac{(lx+my+nz-c\beta t)^2}{1-\beta^2}+(\lambda x+\mu y+\nu z)^2 + (Lx+My+Nz)^2=a^2,$$

where (l, m, n) are the direction cosines of the velocity $c\beta$ and a is the rest radius. On account of relations of the types

$$l^2+\lambda^2+L^2=1,$$
$$lm+\lambda\mu+LM=0,$$

this is reducible to

$$\phi(x, y, z, t)=a^2, \quad . \quad . \quad . \quad (1)$$

where

$$\phi(x, y, z, t)\equiv\psi(x, y, z, t)+\frac{1}{m_0{}^2c^2}\{W(x, y, z, t)\}^2, \quad (2)$$

$$\psi(x, y, z, t)\equiv x^2+y^2+z^2-c^2t^2, \quad . \quad . \quad (3)$$

$$W(x, y, z, t)\equiv\frac{m_0c\beta}{\sqrt{1-\beta^2}}\left(lx+my+nz-\frac{ct}{\beta}\right) \quad . \quad (4)$$

(m_0 is the rest mass of the electron). The function ψ

represents a Maxwellian wave surface travelling with the fundamental velocity c, and the function W is the action function and consequently represents a de Broglie-Schrödinger wave surface travelling with the velocity c/β. Relative to an observer travelling with the velocity c, the Maxwellian function ψ disappears from W, and the Schrödinger wave surface coincides with the surface of the electron, both in fact reducing to a plane Maxwellian wave surface

$$l_1x_1 + m_1y_1 + n_1z_1 + ct_1 = 0, \quad . \quad . \quad (5)$$

where the suffix 1 relates to the new observer. This suggests that our electrons would appear from a ray of light as rays of light, and a similar argument may show that our rays of light would appear as electrons. This reciprocal relation between matter and radiation involving a dual aspect of each, if accepted as a principle, may help to elucidate problems of interaction between these two fundamental entities of physical science. Fuller details will be published later.

A. M. MOSHARRAFA.

Egyptian University,
Cairo, Sept. 19.

Magnetic Reaction of Carbon Filaments.

AN ordinary magnet, or a current carrying winding adjacent to the filament of a carbon filament lamp, produces the oscillation shown in the accompanying photograph (Fig. 1) when the filament is glowed, the effect commencing at the dark heat radiation point and increasing with increasing filament radiation.

FIG. 1.

When filament and winding currents are both direct, simple distortion occurs. The cold filament placed in actual contact with a magnet shows no affinity thereto.

It thus appears that, when radiating, the carbon filament assumes magnetic properties which may be due to

(1) Decrease of inertia of the filament ;
(2) Atomic rearrangement ;
(3) Impurities in the filament.

Regarding the last, some filaments have been produced from a colloidal zinc salt.

As a matter of interest, tungsten and tantalum filaments gave no magnetic reaction, though it should be said that these filaments are more rigidly supported than the carbon type.

The best results are obtained with a carbon filament lamp having large and few filament coils, for example a 150-volt size.

Using a horseshoe magnet, positions of maximum magnetic disturbance will be found when the poles are in the planes of the coil axes, the effect decreasing gradually towards the mid-points.

CEDRIC W. MARSHALL.

Sandfield, Headingley,
Leeds.

Rearing Experiments with Starfish and Obstetric Toads.

PERHAPS readers of NATURE would be interested to hear the results of two rearing experiments which were carried out under my supervision this summer by two of my pupils in the Zoological Laboratory of the Imperial College of Science.

(1) The common starfish, *Astenas rubens*, was obtained from Plymouth. The eggs were artificially fertilised and the larvæ were reared through their entire development, until they metamorphosed into young starfish—a process which occupied $2\frac{1}{2}$ months. This feat had been accomplished in Plymouth and in Millport, but this is the first time that it has been done with eggs which travelled 226 miles from the sea. The development and beating of the larval heart were studied. Mr. Murtri, the pupil who carried out the experiment, also studied the development and beating of the larval heart of *Echinus miliaris*—a species which we rear in our aquaria through its entire development every year. The heart of *Echinus* beats almost four times as fast as that of *Asterias*.

(2) Through the kindness of Mr. E. Boulenger, director of the Aquarium of the Zoological Society, a consignment of thirty specimens of *Alytes obstetricans* were obtained from Germany. These were entrusted to the care of my pupil Miss Sladden, who has great skill in rearing Amphibia. Eighteen of the specimens were removed to our greenhouse, in which a temperature of from 80° to 85° F. was maintained to see if they would become acclimatised, but almost all of them died within a few weeks. The remaining 12, including two males carrying eggs, were kept under approximately natural conditions and all survived. Each of the two males carried from 30 to 40 eggs ; from each batch 20 tadpoles hatched out. Of these 40 tadpoles, no less than 38 were successfully reared through the metamorphoses. After metamorphosis 18 of the young toads were transferred to the greenhouse, 10 were transferred to an out-of-doors vivarium, and 10 to an indoors vivarium. The little toads are now two months old, and only one has died—that one being amongst those subjected to warmth.

Thus Kammerer's statements that *Alytes* could become acclimatised to a high temperature and that in these circumstances it would revert to a water-inhabiting life have been confirmed. Whether we shall have the skill, resources, and time to rear further generations of *Alytes* is still on the "knees of the gods".

E. W. MACBRIDE.

Imperial College of Science,
South Kensington,
London, S.W. 7.

Age of the Tahitian Coral Reefs.

DR. CYRIL CROSSLAND (NATURE, Oct. 12, p. 576) refers to my discovery of coral fragments in a parasitic tuff-cone at Tataa Point, at the north-west corner of Tahiti. The size and water-worn character of these fragments and of the associated basaltic pebbles in the tuff suggest that the cone was built by eruptions through an old beach sprinkled with coral debris. Had the eruption burst through a solid reef, it may reasonably be supposed that large angular blocks of

coral would be found. Dr. Wayland Vaughan and Dr. J. E. Hoffmeister agree as to the age of the corals. The latter writes: "Most of the fragments seem to belong to *Porites*, two to *Acropora*, two to *Pavona* and two to *Pocillopora*. The *Pavona* is of the same type as *P. duerdeni*, Vaughan, or *P. maldivensis* (Gardiner), which are common in the Pacific of to-day. As Dr. Vaughan has said, there is nothing in this collection which might lead one to suspect that they are older than Pleistocene." He adds that among a collection of recent corals, made by Prof. Setchell, from the barrier reef off Papeete Harbour, he can find none common to the Tataa fauna.

Only one-third of the Tataa cone now remains, but it is clear from the attitude of the bedding that the original vent lies beneath the lagoon, and that the outer edge of the cone formerly extended on to the site of the present barrier reef. The denudation of the cone must have occurred before the rise to the surface of the barrier reef, since it cannot have been effected by lagoon currents alone. Moreover, the trend of the barrier reef ignores the original outlines of the cone.

At the exposed base of the cone, that is, at the edge of the lagoon, the tuffs lie either horizontally or roll at low angles, and in places, for a few inches above water-level, they show current-bedding. At higher levels the dips of the tuffs increase to 30° away from the lagoon. It seems, therefore, that the basal tuffs were laid down at sea-level. From the foregoing it appears that since the formation of the Tataa cone the growth of the barrier reef in this part of Tahiti has been unaccompanied by any subsidence of the land relative to sea-level. Unfortunately, there seems to be no evidence as to the depth from which the reef grew during this period.

HOWEL WILLIAMS.
Geological Department,
Imperial College of Science,
South Kensington, S.W.7,
Oct. 21.

Science and Parliament.

IT must be gratifying to all readers of NATURE to learn from the leading article in the issue of Oct. 26 that science will now have a group of members of the House of Commons who will, to some extent, look after the interests of the country in matters where science is concerned. This is due to the secretary of the Association of Scientific Workers, a body which is devoted to furthering the interests and usefulness of all who are engaged in scientific work. There is, so far as I know, no other body with the same aims; at least none which represents all branches of science. I say all branches of science because it can scarcely be said to represent—unless it be vicariously—all scientific workers, as its numbers are small compared with the great number of possible members. Those who know of its work realise that in its brief existence it has done a great deal to forward the interests of science. The increase in the Treasury grant for scientific publications was obtained through the efforts of this body, which has also done much useful work of a kind that cannot well be made public.

The membership of the Association of Scientific Workers has never been large, although it has always been representative. Now that it has in a definite way, as stated in the leading article in NATURE, become actively connected with the Parliamentary Committee, those scientific workers who have hitherto refrained from joining would do well to consider if the time has not come when they should do so. Certainly, if science is to become powerful in Great Britain, it will be necessary for all its votaries to band together in support of the only organisation which seems likely to be able to bring this about. If this is not done, the work will be crippled for want of funds. It cannot be expected that the British Science Guild and the British Association will be able or willing to subsidise the Association, and the present membership is insufficient to provide the necessary funds. A largely increased membership is needed, not only for this purpose but also that all shades of opinion and all groups of workers may contribute their quota to the coherent expression of the aims of British science and to the setting forth of its willingness and ability to assist in guiding the destinies of the Empire.

J. H. COSTE.
Teddington, Oct. 26.

Properties of the Electron.

IT has been shown by me (*Phil. Mag.*, **7**, p. 493; 1909) that some of the main difficulties of the Bohr atom disappear if the electron possesses the property that it absorbs radiant energy during its motion, which induces a decrease of its electrical field, and under certain conditions ejects again the energy as radiation. A deduction of these properties was given based on thermodynamics and kinetic theory, which will be further elaborated in subsequent papers. The results may also be obtained in other ways, one of which will be pointed out here.

Suppose that an electron gas kept at constant temperature is subjected to a powerful magnetic field. The path of each electron will now possess greater curvature than before, resulting in an increased transformation of its kinetic energy into radiant energy, due to the acceleration it undergoes. A limiting case is that the concentration of the electrons is so small that in most cases they pass clear across the chamber. Thus the kinetic energy of the electrons will continually decrease. But this is manifestly an absurd result. Hence each electron will, on the average, recover its velocity during collision. This can take place only at the expense of the surrounding radiant energy, since the kinetic energy lost took this form. If radiation has the orthodox form, namely, that it consists of continuous electromagnetic waves, the electron can recoup the lost energy only by the gradual absorption of radiation which is stored up as internal energy. Since the emission of radiation due to the acceleration of the electron depends on the curvature of its path, the rate of absorption of radiant energy will similarly be dependent. The increase in velocity during a collision of the electron can be produced only by an increase in its field during the process, its internal energy supplying the necessary energy. Hence its field decreased during its mean free path.

R. D. KLEEMAN.
Union College,
Schenectady, N.Y., U.S.A.

Distribution of Medical Works.

WE have been so much struck with the justice of the reviewer's comments in NATURE of Oct. 26 upon the limitation of the sale of Dr. Van de Velde's book, "Ideal Marriage", that we have decided for the future to sell it, not only to members of the medical profession, but also to biologists and other men of science, psychologists, sociologists, and representatives of scientific education and research.

WILLIAM HEINEMANN (MEDICAL BOOKS) LTD.
J. H. A. ELLIOT, Managing Director.

Imperial Mycology.

THE second Imperial Mycological Conference was recently held under the auspices of the Imperial Bureau of Mycology, the first having taken place immediately before the Imperial Botanical Conference in 1924, when it was resolved that a Conference should be held every five years. The Imperial Bureau of Mycology has as its work the assisting of overseas phytopathologists and the publication of an abstracting journal of applied mycology.

A Conference such as the one just held is advantageous for many reasons, most of which are obvious when one considers the comparative isolation of several of the workers in this vast subject. Moreover, the necessity for appointing plant pathologists or mycologists was recognised only comparatively recently in many parts of the Empire, with the result that several of the men who hold such posts have obtained their training and experience since the War. With great responsibilities, it is to their advantage to meet men similarly engaged, whether the crops with which they have to deal are the same or not. Planters as a class are interested merely in the successful growing of crops, and no matter what the crop or which the region, the chief interest of the phytopathologist as such is the same. Consequently, it was a wise move to issue a somewhat general invitation to home workers to contribute to the discussions.

A further point is that these conferences enable a degree of co-ordination of policies, and a taking stock of the present position of research in several matters of outstanding importance. Thus there was a discussion on virus diseases, which are so prominent in all pathology, one on the root diseases of orchard and permanent crops, one on the epidemiology of some cereal diseases, and one on fruit storage rots. Furthermore, the opportunity was taken to define the lines on which meteorological records and forecasts could best be utilised in the more exact timing of preventive spraying against crop diseases. Some of these matters would have been discussed whether or not they had a place in the formal programme, and the time given to them probably marked out the scope for extra-mural talks.

The resolutions which were passed at the close of the Conference give a summary of the main trend of the proceedings, and show the large part played by matters directly and indirectly concerned with plant protection. To aid in a discussion on the existing organisation of plant pathological (plant protection) services in various parts of the Empire, a list was compiled giving the branch of government service under which plant protection is placed, the members of the scientific staff, the inspectorate and co-operative personnel and 'projects under way'. The increase in the numbers of plant pathologists in some countries (for example, Canada) during the past few years is striking, and doubtless explains to some extent the claims of British universities that there is a great demand for biologists overseas; a friendly rivalry to create the most efficient research and administrative service may keep the demand steady for some time, but the proportion of workers trained overseas is steadily increasing.

A change comparable with that in the number of plant pathologists is seen in the plant protection regulations of the dominions and colonies. Much has been made of the political and economic aspects of certain recent regulations which have as their avowed object the prevention of the introduction of disease, but the experience of the United States with chestnut blight and pine blister rust, to take two well-known examples, are sufficient warrant for measures analogous to those for dealing with plague, cholera, or small-pox. The chances of introducing a 'new' disease into a country are nowadays almost incalculable, and when air traffic attains the dimensions prophesied for it we shall have to take other factors into account, for plant disease is more easily disseminated than human disease.

There is considerable diversity in the regulations of the different overseas areas, and it would doubtless ensure that they were more efficiently carried out if there was some standardisation. Obviously, there are difficulties in co-ordinating legislation for widely separated areas, but differences between that of say Kenya, Tanganyika, Uganda, and Zanzibar seem unnecessary. The Conference recommended that countries between which planting material frequently passes should endeavour to group themselves together to investigate the possibility of finding a minimum treatment for any specific pest or disease of a particular plant of which the export is desired.

Most of the dominions and colonies have taken measures to exclude specific plants either completely or from certain countries; sometimes all plants from certain places are excluded. Frequently, specified plants are allowed entrance subject to licence from the local authority, the conditions of the permit not usually being published though sometimes obtainable by intending importers. This is carried so far in Tanganyika that no living plant may be imported except under permit. Where well-known diseases are in question, official certificates are often required, usually to the effect that the disease is not known either in the country or in the district of origin; or only varieties proved to be immune are allowed entry. Many governments require the specified plants to be grown for some time in quarantine, and the Conference was of opinion that such provision should be included in all plant protection legislation. Most governments provide for the compulsory examination of all plant imports and the destruction or treating of plant packings.

Such regulations refer to the importing of plants, and countries wishing to export have to take them into account. But, as in human disease, the health service of the country itself is of chief concern, and import regulations are only an attempt to prevent the spread of disease to crops grown

within a given area. The measures for what is sometimes called 'internal plant protection' need not be co-ordinated between the different overseas countries; what is needed is that the most efficient methods for ensuring healthy crops be adopted, and this is a matter for each individual government. Usually, inspectors are appointed with powers to inspect crops and to prescribe specific treatment. The authority to destroy diseased plants may rest with the inspector but ranges up to a Minister; and similarly with powers of quarantine which may involve whole districts. Usually, compensation is payable at the discretion of the government, but this may be restricted to the destruction of healthy plants. Further, a grower may be compelled to destroy all dead plants of a crop, or may be forbidden to allow cultivated land to run wild unless the crop is destroyed.

A somewhat different aspect of the matter is seen in South Africa, where the majority of growers in an orchard area may request that the provisions of the Orchard Cleansing Act be applied to that area—and in Kenya, where a coffee plant may not be moved to another estate except under permit from the Director of Agriculture.

That special attention should be given to nurseries is obvious. It is usual for registered nurseries only to be allowed to offer plants for sale under an annual certificate of inspection and freedom from disease.

Most countries issue certificates of health for exports where needed, and occasionally no export is allowed without such a certificate. The Conference was of opinion that the system of certificates should be universally recognised, and drew up a form of certificate for approval and adoption.

Plant protection is given a more familiar bias in South Africa, where it is the declared policy to permit only imports of varieties or species that cannot be procured locally in adequate quantity and quality. Permission to import plants or cuttings is not given if seed will do. Here we have a similar regulation to the one which caused considerable uproar when passed by the United States a few years ago, and has meant so much 'dumping' of Dutch bulbs into Great Britain. The reference to seeds is interesting; for seeds seldom appear to be subject to import regulation. It is becoming recognised that seed-borne diseases are more important than was previously considered, and as the result of a discussion, the Conference suggested that the subject should be given increased attention throughout the Empire.

The need for a series of handbooks on the diseases of tropical and subtropical crops is much felt by those who are concerned mainly with two or three of these crops, for information is scattered over many periodicals. A subcommittee which was appointed to consider this drew up a list of eleven subjects and a provisional scheme of treatment, but it emphasised that "the series must be of outstanding merit, otherwise it would be preferable to drop the scheme altogether".

The difficulties met with in tracing accounts of the diseases of a given crop are as nothing when compared with that of finding a way through the tangle of the literature of mycological taxonomy, and it is well worth noting that, in a Conference where the so-called practical side of mycology was rightly predominant, the first resolution passed concerned systematy. It was decided to refer to the International Botanical Congress the necessity for an abstracting journal of the world's literature on mycological taxonomy. This indicates a more general interest in pure mycology than has been apparent during recent years, and one which, if it is developed in the spirit of those men who have done most for phytopathology both at home and in the overseas Empire, will surely bring forth abounding results.

Search for an Oil-Pool in Kent.

By HENRY B. MILNER.

ONE would have imagined that the history of oil exploration in the British Isles was sufficiently common knowledge to shake the faith of the most ardent believer in undiscovered resources, but apparently not. The attack on sub-Wealden hydrocarbons has broken out afresh, this time in Kent, and the possibilities of great finds of oil are optimistically envisaged. We are informed that permission has been granted by the War Office for a well to be put down on land given over to the rifle ranges near Hythe, and that the operators responsible for the project anticipate a 'strike' at about 1000 ft.

It would be interesting to learn the technical grounds (if any) on which hopes of such a discovery are based. That competent geological opinion has been sought, or that this proposed venture is the result of closely reasoned evidence, it is difficult to believe. We thought that the myth of enormous natural gas reserves, of which Heathfield, Sussex, was once considered to be an active indication, had been exploded long ago, so far as the Weald was concerned; maybe this present project has been conceived quite independently of any regard for what the concealed rocks of Sussex may or may not hold, though we can scarcely credit even elementary geological conceptions with disinclination to associate the two possibilities.

The geological column beneath Hythe cannot fail to be a most interesting and scientifically important link in the chain of evidence of the pre-Cretaceous rocks of the coastal margin of the Weald; to this extent a deep boring, carefully logged and sampled, is a most welcome happening. Presumably the operators in question have some idea of the rock succession they propose to traverse, and one is led at once to speculate on what data they rely for their forecast, not only of the occurrence of petroleum, but also of the rocks with which

it is destined to be associated. They at least have one or two theories to work upon; it is not improbable that they have consulted some of the official records of deep borings in the neighbourhood, or the learned papers on the concealed rocks of the county. But even these can only serve as an approximate guide to circumstances, as underground conditions are obviously changing rapidly beneath this corner of Kent, and a great many things may happen to which existing evidence affords not the slightest clue. Hythe and its environs, in fact, constitute rather a blank spot in our present knowledge of subsurface tendencies, and it will be certainly an enlightening development if this boring goes to any great depth.

Arguing on the estimate of oil occurring at about 1000 ft., we can safely dismiss the possibility that Palæozoic pools are the object of the search; this is all to the good, since it saves any discussion on 'coal-oil' relationship and will not be an encouragement to those who advocate the universal application of White's theory to reconsider the problems and deeper significances of the Kent coalfields. In point of fact, the supposed reservoir must be looked for much higher up in the geological scale, and we are forced back to our old friends the Portland Sand and underlying Kimmeridge Clay, the former to contain the pools, the latter (presumably) the mother-rock. Other horizons, the Oxfordian and Liassic clays, even if potentially oil-bearing rocks (which is more than doubtful), may be excluded either on account of possible absence or great depth at which they occur in a synclinal structure.

There is little doubt that the Kimmeridge Clay, as a formation, is mainly responsible for the bituminous manifestations in sub-Wealden rocks, especially the natural gas of Heathfield, and that where the Portlandian assumes a dominantly sandy character, it acts as a natural reservoir rock, a feature denied to the subjacent clay by the noteworthy absence of 'open' beds throughout its development. There is equally little doubt that small quantities of mineral oil do occur in association with these beds, but these are so insignificant as to be unworthy of more than passing mention. The conditions governing the formation and subsequent changes in the Kimmeridgian deposits were plainly biased to the production of oil-shale rather than liquid petroleum, with a minor accompaniment of a somewhat dry and very 'marshy' natural gas, conditions which can be paralleled in many other regions of the world. There is absolutely no technical evidence in favour of the possibility of this formation yielding oil in quantity either to indigenous reservoirs or to suitable containers above it; this applies to its development all over the country. It is, therefore, difficult to believe that it has changed its character beneath this small patch of Kent.

This, however, is not all. Even granting that the Kimmeridge Clay may have locally assumed the dignity of a prodigious oil-bearing mother-rock, if there is one place where one cannot be quite certain of the immediately overlying succession, it would seem to be Hythe and Romney Marsh. Beneath the normal Greensand of this locality the Wealden deposits occur, at least 500 ft. thick, increasing seawards by virtue of a synclinal attitude. The base of these beds may rest on anything from Purbeckian to Kimmeridgian: in other words, it is quite within the realms of probability that the Portlandian may be cut out altogether, as we know from the Elham boring, for example. In such an event, the prospective reservoir ceases to exist (since the lowermost beds of the Wealden are lithologically 'tight'), and any oil occurring in the Kimmeridge beds is still not much more mature than the idle globule.

There is, however, some evidence that the Portlandian deposits thicken westward beneath the Cretaceous cover, and this affords a chance of there being a small but suitable development beneath Hythe of the desired reservoir rock. A rough calculation from available data makes it apparent that, given the subsurface sequence to include the Portlandian, a 1000 ft. well would land just about in the middle of that formation, and this, supposedly, is the goal of the adventure.

Assuming, therefore, that the well-log ultimately demonstrates this anticipated sequence, we arrive at results which are familiar from many of the deep borings in Kent and elsewhere in the Weald, and there is not the least hope of the Portland-Kimmeridge combination proving more attractive as regards oil at Hythe than at any other locality.

Throughout these notes we have taken but little account of structure except to mention casually a general synclinal tendency. There is little doubt that the Jurassic rocks in this part of Kent are thickening considerably as traced from north-east to south-west, one of the main arguments in favour of Lamplugh's sub-Wealden geosyncline. Although some kind of anticlinal structure is favoured with regard to oil accumulation in general, admittedly it is not an essential condition. There seems to be no suggestion of anticlinal developments in the subsurface rocks of Hythe; on the contrary, the relevant beds in connexion with this supposed oil-pool have a decided seaward dip, if our reconstructions are correct; they are, in effect, part of the syncline. Now oil can occur in synclinal structures, but only under very precise conditions in which hydrological factors are peculiar; there is definite evidence that such hydrological circumstances are far from being realised in this part of England, hence we can hold out no hope of a unique synclinal accumulation. Thus does the conception of controlling structure prove equally discouraging.

It is, perhaps, a little unfortunate that the best site for the well should have been picked on Government ground, since it suggests that there may be some official backing for the enterprise. If this is so, we may at least plead for one important thing: that the boring be officially inspected from time to time and a record of the beds traversed compiled by competent authority, preferably the Geological Survey. If the oil be elusive, as oil so frequently is, then at least we shall by this means ensure the addition of the results of another deep boring to our knowledge of sub-Wealden geology.

Obituary.

MR. FRANK E. BAXANDALL.

WE greatly regret to record the death of Frank E. Baxandall, which took place on Oct. 30 at Cambridge, in his sixty-first year. He was a native of Keighley, and after obtaining his degree of A.R.C.Sc. at the Royal College of Science, London, entered the service of the Solar Physics Committee under Sir Norman Lockyer. The chief part of the work at that time (1888) consisted of the observation of sunspot spectra and their reduction with respect to chemical origin and variation during the sunspot cycle. The great impetus to astrophysical research instituted by Prof. E. C. Pickering at Harvard College Observatory, Mass., resulted in similar instruments being installed at the Solar Physics Observatory, and Baxandall's duties were then extended to take part in subsequent night observations, taking photographs of stellar spectra with the new 6-inch Henry prismatic camera, and also the work of reducing the spectra for inclusion in a comprehensive analysis of the brighter stars which was published in 1892.

Soon after, it was realised that the then existing information concerning the available terrestrial spectra was inadequate for the reduction of the better stellar spectra given with the new equipment, and provision was made for an entirely new series with a large concave grating which had been obtained from Prof. Rowland at Baltimore. From this time, Baxandall's inclination was directed more towards the tabulation and correlation of the celestial and terrestrial spectra, and for some years he was to a large extent responsible for papers published giving the results of the investigations.

After the transference of the observatory and staff to the University of Cambridge in 1913, Baxandall continued this work, making a revision of part of Rowland's Tables with special reference to the elimination of blended lines which had in the past led to important misidentifications of details of spectral types. Quite recently, he was engaged on investigations of the spectra of several variable stars.

When Baxandall attended the Observatory on the day before his death there was no indication of anything abnormal, and his sudden death came as a great surprise to his numerous friends.

C. P. B.

PROF. AUGUST FRIEDRICH HORSTMANN, a pioneer in the field of physical chemistry, whose investigations of the thermodynamics of chemical processes are well known, died recently in Heidelberg at eighty-seven years of age. We are indebted to the *Chemiker-Zeitung* for the following details of his career. Born at Mannheim in 1842, Horstmann studied under Bunsen and Kirchhoff at Heidelberg, where he was appointed extra-ordinary professor in 1872 and honorary professor in 1889. He conducted numerous researches upon dissociation, vapour-pressure, combustion, chemical equilibria, and solutions, but for very many years his active participation in scientific research was prevented by almost complete blindness. His thermodynamical studies of chemical processes were published in Ostwald's "Klassiker der Naturwissenschaft", edited by Prof. van 't Hoff.

WE regret to announce the following deaths:

Sir Graham Balfour, from 1903 until 1926 Director of Education for the County of Staffordshire, who contributed notably to the progress of technical education in Great Britain, on Oct. 26, aged seventy years.

Dr. Thomas Alexander Wemyss Fulton, superintendent of scientific investigations, Fishery Board for Scotland, from 1888 until 1921, on Oct. 7, aged seventy-four years.

Sir Thomas Hungerford Holdich, K.C.M.G., K.C.I.E., president in 1916–18 of the Royal Geographical Society, on Nov. 2, aged eighty-six years.

News and Views.

THE Nobel Prize for medicine for 1929 has been divided between Sir Frederick Gowland Hopkins, professor of biochemistry in the University of Cambridge, and Dr. C. Eijkman, of Utrecht, for their discoveries in connexion with vitamins. Hopkins' work on vitamins is well known: so early as 1906 he realised that animals cannot flourish on pure protein, fat, carbohydrate, salts, and water, in this respect confirming work by Lumin, Stepp, and others. But the importance of these experiments lies in the fact that he emphasised the point that the failure to live might be due to the absence from the diet of certain unknown accessory food factors, since it occurred even although the animals were eating sufficient food of suitable composition to support growth, as was shown when a source of the accessory factors was added to the diet. These experiments were published in 1912, and from this date the real study of the influence of these factors, or vitamins as they are now called, in nutrition may be said to have commenced. Dietary diseases were not unknown at this period, but other explanations for the symptoms were accepted: the importance of Hopkins' work lies in the new orientation which was given to the study of their causes: thus absence of a factor from the diet may result in failure to grow or other symptoms; previously the symptoms had been explained as due to some influence of the incomplete diet, the deleterious effects of which were neutralised by adding the missing substances.

DR. EIJKMAN will be remembered for his pioneer work on beriberi or polyneuritis. He was the first to realise, in 1897, that the disease arose only when decorticated, or polished, rice was the staple article of diet, and not when whole rice was consumed. He was led to this conclusion by noticing that the poultry of the prison in Java at which he was medical officer

showed paralytic symptoms very similar to those of his patients : the fact that the birds were fed on the rice refuse from the prison strongly suggested that the disease had a dietetic origin. But at this time the theory of accessory food factors had not arisen, and he considered that the cortical part of the rice grain neutralised the deleterious effect of a diet containing too much starch. His work, however, provided investigators with a suitable test animal for the antineuritic vitamin B, as it is now called, and the relationship between the vitamin and beriberi has been firmly established by many subsequent experiments. Even though this vitamin has now been shown to be constituted of two (or more) factors, the relationship of one to beriberi and the value of the bird as a test object have been again amply confirmed.

ON Nov. 15 occurs the centenary of the death of the French chemist, Louis Nicolas Vanquelin, whose name is associated with the discovery of chromium and beryllium, two of the twenty-eight elements discovered during the eighteenth century. Though less well known than his great contemporaries Guyton de Morveau, Berthollet, Lavoisier, Fourcroy, and Chaptal, Vauquelin attained a distinguished position among French chemists and held many important positions. His principal work, however, was done in his laboratory, where he carried out a very large number of analyses. The discovery of chromium was made in 1797, that of beryllium, formerly called glucinum, in 1798. Vauquelin was the son of a farm labourer in the village of Saint-André-des-Berteaux, where he was born on May 16, 1763, and his boyhood was one of hardship. At the age of fourteen he found employment with a chemist at Rouen, from whence he went to Paris, where, after suffering illness and destitution, he was befriended by a pharmacist named Chéradame, who later on introduced him to Fourcroy, whose assistant, collaborator, and friend Vauquelin became. Altogether, Vauquelin was partly or solely responsible for some three to four hundred scientific papers, mostly devoted to analyses. In a short review of his work, Sir Edward Thorpe said, " He described a method of separating the platinum metals, and worked upon iridium and osmium. He investigated the hyposulphites, cyanates, and malates. He discovered the presence of benzoic acid in the urine of animals ; with Robiquet he first isolated asparagin ; with Buniva, allantoic acid ; and with Bouillon de la Grange, camphoric acid." Vauquelin died in his native district at the Château des Berteaux.

THE Empire Marketing Board has approved a grant to the Royal Botanic Gardens, Kew, for the distribution of tung oil seeds to various parts of the British Empire. A further grant has been made to the Paint and Varnish Research Association for research into the technical properties of the oil. The grants are a result of recommendations made by a tung oil subcommittee elected recently by the Imperial Institute. An article on tung oil production appeared in our issue of Aug. 17, 1929, p. 272. The oil is an essential constituent of certain types of varnish. It was used during the War in special water-resistant varnishes which were needed for aeroplane work. Until recently, the world's wants were almost entirely supplied by China, but, after the War, tung oil production was successfully started in America. Supplies from China are fluctuating and of irregular quality, and are not likely to expand fast enough to meet the increasing demand. Seeds have been distributed by Kew to various Empire countries, and promising trials are now in hand in Kenya, Australia, New Zealand, South Africa, India, Ceylon, Assam, the West Indies, Malaya, Burma, Hong-Kong, Cyprus, Tanganyika, and Palestine. The Empire Marketing Board grant will provide for the further distribution of seed from Kew, and for the purchase of the tung fruits for experiments in Great Britain. The second grant will provide for the appointment of a research assistant who will conduct tests on the technical properties of Empire-grown tung oil, and other problems, such as the best methods of extraction and suggested new uses for the oil. Experiments connected with the use of the residue as a feeding cake will also be undertaken.

ALL friends of the late Sir William Boyd Dawkins—and they are many—will be glad to know that the services to science of this great pioneer in archæological investigation are to be fittingly commemorated. On Oct. 30, Sir Arthur Keith declared open a number of rooms in the Buxton Public Library and Museum which have been set aside for his scientific books and archæological collections. A possible feeling of surprise or even of regret that these collections should not have found a home in Manchester or even London, where they would have been more readily accessible to students, must vanish when the reasons for the late owner's decision are taken into account. As Sir Arthur Keith stated in his address at the opening ceremony, Sir William Boyd Dawkins, after prospecting in every county in England, had come to look upon Derbyshire as the area in Great Britain richest in the remains of prehistoric man. Sir Arthur Keith quoted him as saying only a little more than a year ago that " what has been found already is nothing compared with that which remains to be discovered ". In going on to describe Derbyshire as the ' Dordogne ' of Britain, and later the meeting place of converging waves of immigrations and cultures, Sir Arthur did little more than pay an implicit tribute to the insight, the scientific imagination, and the penetration in grasping the significance and value of evidence which were characteristic of Sir William Boyd Dawkins' mind right up to the end of his long career. Of these qualities, now enshrined in the memory of lifelong friends such as Sir Arthur Evans and Prof. A. H. Sayce, who spoke after Sir Arthur Keith, an enduring monument for future generations stands in the collections of prehistoric antiquities which they enabled him to bring together.

ON Saturday, Oct. 26, Sir John Ferguson, M.P., opened the Twickenham Museum at York House, for the housing of local material of interest, ancient and modern. The museum is the outcome of many years' work by the Mayor, Mr. C. Carus-Wilson, who, during his investigations of the local gravels, felt the necessity of preserving the rich geological and archæological

material of the district. The Thames gravels of the neighbourhood have yielded a very rich and varied collection of prehistoric remains, in addition to hitherto unsuspected debris from practically every formation of southern England. Extensive remains of Pleistocene animals have been obtained from a pit at Strawberry Hill. The bones were found at the base of the gravels, 17-20 ft. below the surface, in what was apparently a depression in the London Clay. The animals represented belong to both warm and cold faunas. Bison remains are very numerous. From the same depression a large fragment of a Jurassic coral, with a number of chalk nodules, was discovered. Ashford (Middlesex) and Hounslow have also yielded remains of *Elephas Primigenius* and rhinoceros. During various dredging operations in the Thames in 1885–87, large numbers of Palæolithic implements, and remains of animals no longer found in the district, for example, wolf, fox, deer, were obtained. These are being preserved for comparison with other material obtained from a village site near Teddington lock. It would appear, from the great number of flint cores, flakes, and unfinished implements, that there was an extensive flint knapping industry in the Twickenham part of the Thames valley. The implements found consist largely of scrapers, unfinished or broken spear-heads, and burins. Only one arrowhead was found, and that was of white quartzite. The flint used appears in most cases to have been brought from the North Downs, though a few implements have been made from gravel pebbles. Other archæological remains from the district in the museum include picks ; Bronze age and Saxon spear-heads ; coins, and sixteenth and seventeenth century household utensils from the Thames.

In his presidential address to the Institution of Civil Engineers on Nov. 5, Mr. W. W. Grierson, following the practice of former presidents, dealt with the branch of engineering work with which he has been associated and confined his remarks to questions of transport by road, canal, railway, sea, and air. As a railway engineer whose duties include the supervision of canals, he finds it difficult to see that canal transport in general will prove economical in England. Some of the early canals yielded dividends of 100 per cent a year, and the effect of railways was to bring about a great reduction in charges for canal transport. Transport by road to-day is relatively subsidised and the cost to the community not fully recognised. In the future, this consideration may carry weight in the interests of national economical transport and the road vehicle may become to a greater extent a useful feeder to the railways rather than a favoured competitor. As a successor to Brunel, Mr. Grierson referred to some of Brunel's most successful works, mentioning the graceful brick arch bridge at Maidenhead and the bold timber viaducts used in the south-west of England. Some of these timber structures carried ordinary traffic drawn by locomotives weighing up to about 82 tons until quite recently. With regard to railway electrification, while the superiority of electric traction on suburban lines has long been established, Mr. Grierson regards it as doubtful whether it would prove economical for main lines in Great Britain. Statistics of European railways show that electric traction is adopted on main lines largely where water power is available and where coal is scarce ; and where steep gradients favour the electric locomotive.

In the *Quarterly Transactions of the British College of Psychic Science* for October appears a note by the editor, Mr. Stanley de Brath, who deals with the article published in NATURE on Feb. 9, 1929, under the title of "Modern Witchcraft". The author, when referring to the plea for a comprehensive and adequate scientific examination of the facts, regards this investigation as already made, and in support of his assertion points out the inquiries of such observers as Sir William Crookes, Dr. A. R. Wallace, Prof. Hyslop, and Dr. Geley. The article illustrates in a somewhat striking manner the misunderstanding which exists in the mind of the public as to the nature of scientific inquiry and the relative value of the theories deduced thereby. Mr. de Brath's list of authorities signifies but little. Scientific men have, unfortunately, often been persuaded of the reality of things which we now know were but delusions. The history of the famous *N*-rays aptly illustrates this point. Moreover, the selection of the names is not altogether happy. Sir William Crookes's investigations of the medium Florence Cook are recorded nowhere with that attention to detail which scientific scrutiny demands. The credulity of A. R. Wallace also regarding spiritualistic phenomena is known to everyone who is capable of interpreting facts. Similarly the experiments of the late Dr. Geley in the Institut Métapsychique International were not such as inspire the confidence of scientific men in other fields of work.

The whole position regarding investigation of alleged supernormal phenomena is one which it would be well for scientific inquirers to understand. It would appear obvious that the first essential in investigating a medium for the so-called physical manifestations is that measure of control which will effectually prevent the production of those manifestations by normal means. But the senses are hindered in almost every possible way and the investigator reduced to a powerless spectator at a performance which is really a burlesque travesty of scientific experiment. On the other hand, the serious visitor may refuse to accept the 'conditions' : he may object to having his senses stifled and he may demand a few of those reasonable precautions which seem to him necessary. In fact, he will refuse to take the part of a mere looker-on and will ask to be allowed to participate in practical experiment. In this case it will usually be found that his presence is undesirable or that his unsympathetic vibrations disturb the phenomena ; and the natural result is that he will not be asked again to attend. The cause of 'psychic science' will not be furthered by such methods. Can it be that it is only through following these conditions that 'supernormal' phenomena become apparent ?

In our issue of Aug. 3, 1929, mention was made of a series of articles published last year in the *Times of India* by Prof. John Maclean, of Wilson College, Bombay. In those articles he advocated contact with reality in the teaching of mathematics on the ground partly of the direct usefulness of such mathematics, but more especially because of its value from the point of view of general education. In a further series of eight articles published this summer in the same journal, Prof. Maclean discusses by way of example the application of mathematics in a number of walks of life, in literature, history, agriculture, medicine, physics, chemistry, and the increasing mathematical equipment that is now required of the economist. In many cases he finds that a device is used in one walk of life but is unknown in other walks, although it would also be of great use in them, and shows the advantage that all would gain by the pooling of this mathematical knowledge. He finds in one profession some elegant and enlightening manner of exhibiting a set of statistics, while other professions know nothing of this, and exhibit their statistics in a clumsy and uninforming way. He finds also that a profession which furnishes one elegant piece of treatment may be clumsy in other cases, in which another profession is more elegant. Prof. Maclean makes a good case for the scrapping of irrelevant mathematical matter and the substitution of a suitable treatment of statistics. The scheme is already at work with very good results in the first year course of the University of Bombay.

Several valuable papers were read to the Association of Public Lighting Engineers held at Bournemouth in September last. Some of these papers are reproduced in the *Illuminating Engineer* for October. The president, S. B. Langlands, the public lighting engineer to the city of Glasgow, pointed out that the duties of the street lighting engineer were increasing daily. In Glasgow the care of police signals, traffic signs, and street clocks was part of his duty. In addition, street name tablets and street numbers would probably soon be illuminated. The reflective power of the road was discussed with the city engineer and the visibility of policemen with the chief constable. In Glasgow the policy of establishing a lighting department had been a great success. Some cities, like Glasgow and Leeds, spend more than four shillings per head of the population per annum and some, like Sheffield and Birmingham, only spend about half this amount. The rateable value of Glasgow exceeds eleven pounds per head, whilst in Sheffield it is less than five pounds. There is need, therefore, of some uniform assessment procedure. In Great Britain all the expenditure for public lighting is met by assessments, but in America the costs are often partly defrayed by contributions from business houses which benefit directly from the improved illumination. The gas industry cannot afford to ignore the question of gas mantles, and it would be in the true interests of the electrical industry to reduce appreciably the price of electric lamps. For public lighting the cost of electricity in Glasgow is $1\frac{1}{4}d.$ per unit, but the electricity commissioners hope that this will soon be lowered to $\frac{1}{2}d.$ per unit. In America it is the standard practice for progressive cities to spend at least two dollars (about 8*s*. 4*d*.) per head per annum for street lighting service.

The popular notion that many animals possess a language of their own, through which they communicate to their own kind their wishes, thoughts, and feelings, has received a certain amount of support from experiments having a sort of scientific flavour. But a critical examination of the facts throws a different light upon the problem. In an article on "Animal Language in its Relation to that of Man" (*Biol. Proc. Cambridge Phil. Soc.*, vol. 4, July 1929) J. A. Bierens de Haan analyses the alleged evidences of animal language and decides against the believers. He concludes that animal language in all its essentials is inferior to that of man. It is rarely vocal, scarcely ever articulate, and has no words in the sense of sounds bearing a conventional meaning. The sounds are uttered unintentionally, show no capacity for development, and do not indicate anything, though they express feelings and emotions. Real creative language, the faculty of combining words into phrases, is beyond the faculties of the animal mind. Even in contact with man, animal language in its highest form remains the language of an animal. It seems that an unbridgeable gulf here separates man from the animals. Nevertheless, the subject has seldom been treated with the serious study which it deserves, and the author commends it to biologists and animal psychologists.

The announcement of the intention of the Southern Railway Co. to electrify the main line between London and Brighton marks an epoch in the development of electric traction in Great Britain. It was made possible by the Budget of 1929, in which the Government duty on passenger fares was remitted on condition that the money was expended on improving the railway systems and bringing them up-to-date. In a paper in the *Electrical Review* for Nov. 1, A. T. Dover gives interesting details of the proposed conversion of the Brighton line from steam to electric traction. The distance of 51 miles is relatively short, the route is level, and the passenger traffic is exceptionally heavy. The fastest trains take an hour and the ordinary expresses 15-30 minutes longer. The train weights are 200-350 tons, and quadruple tracks are provided over practically the whole route. With electric traction it would be quite possible for the 'limited' trains to do the journey in 45 minutes and for ordinary expresses to do it in about an hour. This improved service with additional trains will doubtless attract the additional traffic which the railways need. The direct current system which is the standard for Great Britain will be employed. The existing 650-volt conductor rail system will be used. The main line trains will probably be hauled by electric locomotives similar to those used on the Continent, which give an output up to 1000 horse-power per axle. Speed control is now very much more flexible than in the early days of electric traction. Fifteen economical running speeds are possible by combining series-parallel control and control by the field magnets. The shelving of the

original scheme owing to the War, therefore, has not been all loss.

AN important group of new radio stations was opened last month at Aranjuez, near Madrid. Most of the necessary apparatus came from England, and much of it was erected by British workmen. The stations were designed by Marconi's Wireless Telegraph Co., Ltd. This group of radio stations expands the range of Spanish external communications. Madrid is now placed in direct radio communication with both North and South America. By means of the Marconi short wave beam installation at Aranjuez, a regular commercial telephone service between Spain and the Argentine Republic is available in addition to high-speed beam telegraph services. The stations belong to the Transradio Espanolo, and special receivers for them have been constructed by the Marconi engineers.

MORE than forty nations have now accepted the Government's invitation to take part in the World Poultry Congress to be held at the Crystal Palace on July 22–30, 1930. Of these, no fewer than twenty-three have established national committees for the purpose of organising their representation at the Congress and the accompanying exhibition. It is already apparent that the forthcoming meeting will exceed in size and effectiveness any previous exhibition of a similar character that has yet been held. The decision to extend the scope of the exhibits beyond poultry alone should add to variety and interest. It is proposed to show varieties of rabbits' fur bred commercially in Great Britain along with a range of garments made from home-produced fur, and the Ministry of Agriculture and Fisheries has invited the co-operation of leading horticulturists who will be responsible for massed displays of flowers and plants throughout the exhibition.

THE Report of the Ordnance Survey for the year ending Mar. 31, 1929, records a steady progress in the revision of the maps of Great Britain. About half the sheets of the 25-inch and 6-inch maps of England and Wales, and most of the sheets of southern Scotland, have now been revised. Road revision for 110 sheets of the Popular edition of England and Wales subsequent to the third revision has now been carried out. In the third revision of the Popular edition of Scotland 49 sheets have been published and the field-work for the other sheets, including the Hebrides and Shetland, is finished. Work on the fourth revision of the 1-inch map of England and Wales was begun around Plymouth. Corresponding revisions are under way with the smaller scales. Physical maps of England and Wales and of Scotland, a magnetic map of England and Wales, and a second edition of the map of Roman Britain were published. A map of England and Wales during the seventeenth century is nearly ready. It is satisfactory to note that the sale of all Ordnance maps, and especially the 1-inch Popular map, shows an improvement.

AN exhibition of the historical scientific apparatus belonging to the Royal Institution has been arranged at the Science Museum, South Kensington, and will be opened by Sir William Bragg on Friday, Nov. 15, at 4.30 P.M.

THE fifteenth in the series of public lectures on physics in industry, organised by the Institute of Physics, will be delivered by Dr. C. H. Lander, Director of Fuel Research, Department of Scientific and Industrial Research, who will take as his subject "Physics in Relation to the Utilisation of Fuel". The lecture will be given on Wednesday, Nov. 27, at 5.30 P.M., in the rooms of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

COLOURED drawings of the remarkable mosaics, Jewish and Christian, from the synagogue and churches recently excavated at Jerash in Trans-Jordan, by the British School of Archæology in Jerusalem, and Yale University, are on exhibition, by the courtesy of the Palestine Exploration Fund, in its rooms at 2 Hinde Street, W.1 (off Manchester Square), until Saturday, Nov. 16. The subjects of the mosaics include representations of the deluge, views of Alexandria and Memphis, Nile-side scenery, portraits of benefactors and functionaries, studies of animals and birds, inscriptions in Greek and Hebrew, as well as richly designed borders imitating carpets and other textiles.

MESSRS. A. Gallenkamp and Co., Ltd., have issued list No. 75 E of the small electric furnaces which are rapidly becoming popular in the laboratories of colleges and factories on account of the ease with which a constant temperature may be maintained. The firm claims to have been the first makers of small electric furnaces in Great Britain, and the new models have been designed to reduce the cost of heating to reasonable limits. Although the nichrome alloy of which the heating elements are made will withstand temperatures well above 1000° C., this temperature is the maximum for economical working, and the coils are designed to last for more than 1000 hours. At lower temperatures they will last very much longer. They can be adapted to direct or alternating currents at pressures up to 250 volts, and renewal of the coils is easily and cheaply effected. The list includes tube furnaces for use in estimating carbon in steels, furnaces for organic combustions, muffle and crucible furnaces and pyrometers. For higher temperatures silit-tube furnaces are made which are fitted with special non-metallic heating elements resembling silicon carbide.

THE latest catalogue (No. 334) of Messrs. W. Heffer and Sons, Ltd., Petty Cury, Cambridge, should be of interest to librarians and others on the look-out for sets or long runs of scientific periodicals and transactions of learned and scientific societies, and for standard scientific books. Nearly 1800 works are listed. The list is obtainable free on application to the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer for mining courses under the Derbyshire Education Committee—The Director of Education, County Education Office, Derby (Nov. 16). A medical officer in charge of radium at the General Infirmary, Leeds—The General Manager, General Infirmary, Leeds (Nov. 18). An assistant in mathematics in Queen's University, Belfast—The Secretary,

Queen's University, Belfast (Nov. 20). A senior assistant pathologist to the Pathological, Bacteriological, and Clinical Research Department of the Royal Sussex County Hospital—The Secretary-Superintendent, Royal Sussex County Hospital, Brighton (Nov. 21). Three junior research assistants (a biochemist, a histologist, and a physiologist) in the Animal Genetics department, the University, Edinburgh—The Secretary, The University, Edinburgh (Nov. 22). An assistant lecturer in municipal and sanitary engineering at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (Nov. 30). A lecturer in economics and statistics in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, W.C.2 (Dec. 18). A test assistant at the Royal Aircraft Establishment to assist in experimental metallurgical work—A, 385, The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A junior technical officer in the Admiralty Technical Pool—The Secretary of the Admiralty (C. E. Branch), Whitehall, London, S.W.1. A geologist on the Geological Survey Staff, Nigeria.—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An assistant master to teach woodwork, chiefly in the Maidstone Junior Technical School—The Principal, Technical Institute, Maidstone. A junior chemist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Station, Waldegrave Road, Teddington. A demonstrator in agricultural botany in the University of Reading—The Registrar, The University, Reading. Metallurgical research investigators; also a science graduate for the critical examination and abstraction of technical literature in connexion with technical reports, etc., each under the British Non-Ferrous Metals Research Association—The Secretary, British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham.

Our Astronomical Column.

Recent Solar Activity.—A large, naked-eye sunspot of composite structure was a conspicuous object to those persons who watched the phases of the partial solar eclipse on Nov. 1. The spot crossed the sun's central meridian on Oct. 31·0, and there were disturbed magnetic conditions recorded at Abinger on Nov. 1–4. For some hours after 15h on Nov. 3 the magnetic disturbance reached 'storm' intensity, the range in declination being about 36′. It may be noted that disturbed magnetic conditions occurred on Oct. 7–10, that is, about a solar rotation earlier. Another group of sunspots possibly associated with the recent magnetic storm was a stream which, growing rapidly from small spots on Oct. 30, covered an area of 900 millionths of the sun's hemisphere on Nov. 3. Mr. Newbegin at Worthing observed this group with a spectroscope on Nov. 3 and saw that it was unusually active. There were reversals of lines of sodium and magnesium and a brilliant reversal of the *c*-line of hydrogen over the centre of the group. A third spot to be noted came into view round the east limb on Nov. 3 and was accompanied by a metallic prominence. This spot will probably be visible to the naked eye and is the return of one designated No. 10 in the list of spots given on p. 631 of NATURE, Oct. 19. The following table continues the tabulation of large sunspots.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
12	Oct. 24–Nov. 6	Oct. 31·0	10° N.	800
13	Oct. 30–Nov. 9	Nov. 3·7	14° N.	900
14	Nov. 3–Nov. 15	Nov. 9·6	10° S.	500

(Areas in millionths of sun's hemisphere.)

Interesting New Minor Planet.—The discovery of new planets is going on steadily at the rate of more than a hundred per annum. From time to time a discovery of more than usual interest is announced. A planet the provisional designation of which is 1929*SA* was found photographically by Prof. M. Wolf at Königstuhl on Sept. 26. It attracted special notice from the length of its trail, which indicated that it was moving northwards at the remarkable rate of half a degree per day. *Beob. Zirk.*, No. 38, announces that Dr. G. Stracke of the Berlin Rechen-Institut has computed elliptical elements from observations on Sept. 26, 28, and Oct. 7. He finds that the period is 4·375 years, the eccentricity 0·4648, and the perihelion distance 1·432, so that the planet comes inside the orbit of Mars. The orbit is of similar type to those of Aethra and Ganymede. The aphelion distance is 3·918, and the inclination 14·9°. The planet was of magnitude 13 when discovered, it being then not far from perihelion. It will probably be too faint to observe when near aphelion.

The same number of *Beob. Zirk.* announces that M. Gussow, of Babelsberg Observatory, has found that the spectroscopic double star Boss 6046, the magnitude of which is 5·13 and its spectral type *B*3, is an eclipsing variable of Algol type. The light-range is 0·17 mag., and the period of variation 6·067 days; the latter was deduced from the spectroscopic orbit.

The Orbit of γ Centauri.—This is one of the binaries the components of which are nearly equal in magnitude, and approach each other very closely at periastron, so that there is danger of confusing the components when they again become separately visible. Such binaries have generally two possible orbits, one with a short period, high eccentricity, and small inclination, the other with a long period, low eccentricity, and high inclination.

Union Observ. Circ., No. 78, contains a discussion of its orbit by W. H. van den Bos. Dawson had given in *Ast. Jour.* 765, an orbit of the second of the above types (period 200 years, eccentricity 0·3) based on observations from 1852 to 1920. Observations from 1920 to 1928 led van den Bos to conclude that it has a first-type orbit with period 80·4 years, eccentricity 0·86. See had already in 1895 published elements not far from the new ones, but the additional 34 years have greatly strengthened the determination. The components are now too near each other for easy separation, but there is an appeal for spectroscopic observations, which will both check the new orbit and also afford a determination of the star's parallax. This has been estimated as 0·027″ using Eddington's curve connecting mass with absolute magnitude. The mass of each star is estimated as three times that of the sun, absolute magnitude of each 0·0 bolometric, 0·3 visual. A larger parallax would give smaller masses. The relative radial velocity at periastron (1930·2) would be 38 km./sec. with the above parallax. The apparent separation of the stars is a minimum, 0·09″, at the end of 1930, increasing to 0·42″ three years later.

Research Items.

Azande Oracles.—An extensive study of the oracle magic of the Azande peoples of the Anglo-Egyptian Sudan by Mr. E. E. Evans-Pritchard is published in vol. 11 of *Sudan Notes and Records*. Of all the methods of divination employed by the Azande, one, *benge*, stands apart. *Benge* is a red powder obtained from a creeper which, when mixed with water, forms a paste. This paste is administered to chickens, and causes spasms which may or may not end in death, and, according to the results, determining the answer to questions which have been put to the *benge* in the chicken's stomach. The creeper does not grow in the Azande country, but to the south of the Welle and some hundreds of miles away. It is obtained by men who on the journey must observe the requisite food and sex taboos. Any man, but not the women, may consult the *benge* oracle, but when the chief wishes to consult *benge*, it is administered by regular officiators of the oracle of whom the chief has two or three, and each of whom acts for a month at a time, observing the necessary taboos. When any but a chief wishes to consult the oracle, *benge* may be administered by anyone, even the man himself, or a friend, who has observed the taboos. Two consultations of the oracle are necessary on every occasion, and in the second the result must be the reverse of that of the first. Thus if the death of the fowl gives an affirmative answer on the first occasion, on the second it must not die. The method of consultation is for the officiator to hold the fowl between his feet and by means of a grass brush to put down the throat of the fowl one, two, or three doses of the poison; the questioner, sitting in front of him, puts the question to *benge* in the stomach of the fowl. When the case has been put fully before it, the chicken is held up on the hand of the officiator, when the case is again put to it more vigorously, while it shows the effects of the poison. If it is to die, death supervenes in spasms, and it is thrown on the grass. Of the oracles *benge* is the most important. It is used judicially and before all serious undertakings such as marriage. Its verdicts are socially and ritually binding.

Carbohydrate Transformation in the Animal Organism.—In the *Rendiconti* of the Royal Academy of Sciences of the Institute of Bologna for 1928, just received, Prof. Pietro Albertoni gives a summary of experiments made to obtain information as to where, in the animal organism, the transformation of carbohydrates takes place. With a rabbit which has been fasting for 20 hours, moderate quantities (20-25 grams) of glucose do not pass into the circulation, but are completely retained by the liver, the respiratory changes in the muscles being thus unaffected. In general, ingested glucose passes to the various tissues in the proportions determined by the conditions of its absorption and distribution in the organism, its metabolism being more active in the liver than in the muscles. As regards the respiration of the tissues, the mode of behaviour of any substance varies according as it is simply placed in contact with the tissue or reaches this by means of ingestion.

Behaviour of *Caudina*.—Mr. Toshihiko Zamanouchi, in continuing his work on *Caudina chilensis*, has studied its behaviour in a variety of ways (*Science Reports of the Tohôku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 4, No. 1, fasc. 1, February 1929). This holothurian burrows in sand except for the tip of its tail, which is directed upwards, just on the surface of the sea bottom. Here it makes respiratory pulsations day and night, ejecting at intervals a large amount of sand with water. If dragged out of its burrow it will bury itself again by means of the tentacles and body muscles, the heavier the animal the slower the burrowing. In its natural position in the sand the body is soft and flexible with muscles relaxed; if taken out it will harden itself with greatly contracted muscles. If placed on a glass plate movements similar to burrowing movements are made. The whole body is very sensitive to mechanical stimuli, the head part most, then the tail, lastly the mid-trunk. The tail end is negatively geotropic even when severed, the front end positively geotropic. The behaviour of *Caudina* is studied with regard to various chemical stimuli, the entire body surface being very sensitive. Stimulations were made by local applications of the solutions on the body surface. The anterior part of the trunk is the most sensitive, and young animals react more actively than older individuals.

Gorgonacea from Panama.—Prof. Sydney J. Hickson's report on "The Gorgonacea of Panama Bay together with a description of one species from the Galapagos Islands and one from Trinidad" (Papers from Dr. Th. Mortensen's Pacific Expedition, 1914–16. *Vidensk. Medd. fra Dansk naturh. Foren.*, Bd. 85, 1928) contains much that is new. It describes a collection made by Dr. Cyril Crossland during the voyage of the S.Y. *St. George* in the Panama region and the islands of the Eastern Pacific Ocean, together with Dr. Mortensen's collection from his Pacific Expedition. The region lies within the 100 fathom line, and is characterised by the muddiness of the sea, the extensive muddy bottom and few sea-weeds. Nearly all the Alcyonaria present belong to the Gorgonacea and this group is present in profusion. So rich are these muddy waters in species and varieties that systematic work is very difficult. Prof. Hickson finds that the species of *Alcyonaria* found in Panama Bay are distinct from any that have been described from the western tropical Atlantic, but that there is a certain parallelism between the species in the two regions although they belong to different genera, those from the Pacific side being apparently more primitive. These facts are in the author's opinion consistent with the view that there was continuity between the two oceans in early Miocene times. The specimens were well preserved and a valuable record has been made of the state of the gonads in the months of the year in which they were collected. Two new species of *Euplexaura*, one of *Thesea*, one of *Muricea*, and four of *Leptogorgia* are described, and the memoir is illustrated by one coloured and two uncoloured plates besides various text figures.

South African Branchiopoda.—The exceptional richness of the fauna of South Africa in Branchiopod Crustacea is shown by Dr. Barnard's recent revision (*Ann. S. African Mus.*, **19**, p. 181, 1929), in which he describes 49 species. Dr. Barnard has already added much to our knowledge of these interesting Crustacea, but 13 of those mentioned are described here for the first time, and, as he points out, there is still much unexplored territory, so that the list is probably by no means complete. This revision is a valuable contribution to the systematics of the group, since the abundant material, examined on the spot, has enabled the author to estimate the range of variability of the species. His remarks on the genus *Apus* are most valuable. The limits between species are very ill-defined, and the comments on the value of the specific

characters commonly used are based on extensive experience and should be helpful in reducing the genus to order. Of the genus *Lepidurus* no species now lives in South Africa, but one is recorded from the Upper Triassic Stormberg beds. Since *Lepidurus*, unlike *Apus*, usually inhabits clear permanent pools, this fossil species is regarded as evidence of a change of climate since the deposition of the Stormberg series. On the other hand, permanent pools do exist, and provide a home for *Cyclestheria hislopi*, which is not definitely known to produce resting eggs, and there does not therefore seem to be convincing reason for the disappearance of *Lepidurus*.

Insects of Samoa.—The British Museum (Natural History) has issued further fascicules of the "Insects of Samoa", a monographic work describing the insects and other terrestrial arthropods of the Samoan Islands. Previous instalments of this important work have already been noticed in our columns and the parts before us deal respectively with the Myriapoda by Mr. C. Attems, the Araneida by Dr. L. Berland, the coleopterous families Platypodidæ and Scolytidæ by Dr. C. F. C. Beeson, and with a number of different families of Diptera by various recognised specialists. Since the commencement of this monograph in 1927, twenty fascicules have appeared, and when completed the whole work will form an authoritative synopsis of the arthropod land-fauna of the islands in question.

Soils and Fruit of Wisbech.—A survey of the soils and fruit of the Wisbech area, prepared by Messrs. Wright and Ward, of the School of Agriculture, Cambridge, has been issued by the Ministry of Agriculture (Research Monograph, No. 6) as the first of a series of similar publications. The district under consideration occupies an area of thirty-six square miles on the borders of Norfolk and Cambridgeshire. Generally speaking, the geological formation may be classed as silt, though five distinct soil types are recognised. The properties and distribution of these soils are fully described from an essentially practical point of view in the first part of the monograph. Information is also supplied concerning the water in the district, and the methods employed in sampling and analysing the soil. A short history of the fruit industry and an account of present day cultural methods in which pruning, manuring, and spraying are included comprise the second part. In the third part the relationship between soil and fruit and the kind of fruit grown on the various types of soil are described. Each of the main crops such as apples, plums, pears, cherries, gooseberries, raspberries, and strawberries is dealt with in turn, the effect of soil on the growth, liability to disease, size, and keeping qualities of the fruit being among the points discussed. Actual figures in support of the conclusions drawn, full details of the soil analyses, a rainfall table, and a short list of references are given in an appendix. In addition, three detachable large scale maps are supplied showing respectively the areas occupied by the various soil types, and the districts in which tree fruits and strawberries are grown.

Climate and Agriculture in Russia.—In Russia the vast expanse of the plains and the absence of mountains provide a unique example of the regular distribution of vegetation, soils, agriculture, and population in climatic zones. In *Berichte über Landwirtschaft* (Neue Folge), vol. 9 (1929), pp. 478-527, published by the German Ministry of Nutrition and Agriculture, Prof. W. P. von Poletika, formerly of the University of Leningrad, has given an analysis of the geographical distribution of types of agriculture in relation to climatic factors. His paper is especially useful as it summarises many papers and data which have not previously been available owing to language difficulties. The production of vegetable matter per unit area is greatest in the central portion of the broad-leaved forest zone and to the north falls off regularly through conifer forest to tundra with decreasing temperature, and to the south through steppe to desert with decreasing rainfall. At present the northern part of the steppe region is the most highly developed agricultural region, but further intensification, especially to the south, will be limited by the recurrence of summer droughts, at any rate until there is a much better control of soil water by improved methods of cultivation. The moderate climate of the oak climatic zone offers the greatest opportunity for intensification of agriculture. In the dry regions of the Transcaucasus and Turkestan the development of irrigation is made difficult by the prevalence of malaria, the salinity of the soils, and the low cultural level of the inhabitants. The whole discussion is pessimistic and emphasises the serious climatic obstacles to development. It explains the paradox that in spite of its low population density Russia suffers from an acute land shortage. Whilst in population density Russia is comparable with extensively farmed countries such as the Argentine, Canada, and U.S.A., the amount of waste land is so great that the area of cultivated land per head is comparable with that of France or Italy. The future prosperity of Russia must therefore depend not merely on an intensification of the agriculture in the favoured areas, but above all on the exploitation of its mineral wealth and the building up of its industries.

Ordovician Ostracoda from Tennessee.—In studying a collection of Ostracoda from the Trenton Limestone of Nashville, Tennessee (*Amer. Jour. Sci.*, vol. 16), S. R. Kirk found that the majority were referable to *Isochilina ampla*, Ulrich, but that that species ought more properly to be placed in the genus *Leperditia*, the members of which can, however, be graded into *Isochilina*. To avoid creating a new genus to accommodate border-line forms, the author decided to broaden the definition of *Leperditia* so as to include all forms of appreciable overlap and thus to retain the present genera. The representatives of two other genera are described: *Ctenobolina* and *Drepanella*, a new species of which, *D. progressa*, shows features in common with both *Drepanella* and *Klædenia*, thus favouring the idea of the evolution of the latter genus out of the former.

Lower Carboniferous Fossils in Arkansas.—"The Fauna of the Middle Boone, near Batesville, Arkansas", forms the subject of a paper by G. H. Girty (U.S. Geol. Survey, *Professional Paper* 154-B). The introduction gives some geological information concerning the deposits. In a few points the fauna of the Middle Boone shows affinities with that of the Upper Boone from the same area and with that of the 'Spring Creek Limestone', which may be treated as a unit therewith. Substantial conclusion as to the relations of this fauna to the typical Mississippian faunas of Iowa and Missouri is at present out of the question. The only safe statement at present seems to be that this fauna from Batesville is not typical Boone, but more related to the earlier ones of Burlington and Keokuk age. So far as at present known, the fauna here described comprises forty-five more or less provisional species or varieties. It essentially consists of brachiopods, among which the Spirifers are the most abundant, followed by the Producti. The description of the species shows that a few are considered to be new, and four plates of figures of the more interesting forms are appended.

Tango (Japan) Earthquake of Mar. 7, 1927.—This earthquake, the most destructive in Japan since the great Kwanto earthquake of 1923, continues to be the subject of important studies by Japanese seismologists. A new series of precise levellings was made across the central area from April to June 1927, a second series from June to July 1927, and a third from March to April 1928. Mr. C. Tsuboi, in an interesting paper (*Earthquake Res. Inst. Bull.*, vol. 6, pp. 71-83 ; 1929), interprets the changes of level that occurred in the intervals between the series. For different sections of the district surveyed, he gives diagrams on which the displacements of the bench-marks are plotted. These points lie on segments of straight lines, the ends of which for the two intervals lie on the same abscissæ. These facts suggest that the ground of the central district is made up of a number of separate blocks, each of which was able to move comparatively easily after the great earthquake and moved practically as a whole. In some blocks, the tilting occurred in the same direction in both intervals, but, in a few, in opposite directions. The boundaries of the blocks coincide very closely with the faults, many of them of recent date, that have been traced during the geological surveys of the district made since the earthquake. Mr. N. Nasu also contributes to the same journal two important reports on the numerous after-shocks of the earthquake (vol. 6, pp. 245-331 ; 1929 ; and vol. 7, pp. 133-153 ; 1929). He finds that most of the shocks originated at depths of less than 30 km., and that the most active zones are those lying to the west of the Gomura fault and to the south of the Yamada fault (see NATURE, vol. 122, p. 587 ; Oct. 13, 1928). The sensible shocks were connected with the growth of these and other faults, the insensible shocks with the formation of series of parallel cracks due to the shearing stresses applied to the blocks. From the records of clinographs installed in the district, Prof. Ishimoto found that the earth showed a characteristic tilting for several days before a moderately strong after-shock.

Detrital Asphalt.—" The presence of considerable *detrital asphalt* in the Sinbad limestone member of the Moenkopi formation " is an observation made in the otherwise dull memoir on some Utah gas and oil prospects by Mr. J. Gilluly (*Bulletin* 806-C, 1929, United States Geological Survey), and is clearly one inviting description and explanation, which, however, the author does not see fit to give. Again, he speaks of " the *sedimentary asphalt* of the Shinarump conglomerate ", in both cases the italics being ours. Both formations mentioned are of Triassic age and have apparently been laid down in shallow water. Regarding the first, " oolite-like grains of asphalt " occur throughout the particular bed ; the presumption here is that bitumen pellets, sufficiently hard to withstand redeposition from some pre-existing bituminous rocks, have found their way into a basin in which sandy limestone was accumulating, have further withstood the process of consolidation, and finally the test of a long period of geological time. In connexion with the other occurrence of *sedimentary asphalt*, the author argues that this is evidence of the existence of petroliferous rocks of pre-Shinarump age. We wonder whether the use of the words ' detrital ' and ' sedimentary ' in these cases is really valid, and, if so, why the author did not seize the opportunity to describe fully two such interesting and almost unique deposits. Derived asphalt from bituminous rocks which contribute to contemporary deposits, for example, alluvium, gravel, shore-sand, etc., is well known, but an actual case of *detrital* asphalt, if this indeed is the true mode of origin, is surely something quite new, at least in the sense understood in this description, and especially in association with a limestone.

The Katharometer in Gas Analysis.—The katharometer, manufactured by the Cambridge Instrument Company, Ltd., is now extensively employed for carrying out gas analyses in industrial and other processes. Essentially the instrument consists of two heated fine wire spirals constituting two arms of a balanced Wheatstone bridge. If the respective spirals are now surrounded by gases of different thermal conductivity, then the initial balanced condition of the bridge will be upset to an extent dependent upon the difference of thermal conductivity of the two gases—one of which is a standard gas—and the resulting galvanometer deflection will serve to indicate the extent to which a certain constituent is present in the other gas. The method is simple, accurate, quick, is capable of detecting very minute changes in gas composition, and the apparatus has a low time lag, and has for some time been employed for the analysis of flue gases. More recently the apparatus has been used to test the purity of hydrogen and nitrogen and to control the mixture of these gases in nitrogen fixation plants. It is employed to measure accurately the purity of oxygen derived from liquid air. The percentage of helium, neon, or argon present in oxygen or nitrogen is readily indicated. In chemical industry the katharometer has found application in determining sulphur dioxide and organic vapours, for example, acetone, carbon bisulphide. The device is also used in the determination of oxygen in feed water, for determining carbon monoxide, in the analysis of gases used for filling balloon envelopes, for determining carbon dioxide in fruit stores, for determination of humidity, and in physiological determinations connected with respiration. Particulars of these and other applications are contained in List No. 144 issued by the Cambridge Instrument Company, Limited.

The Positive Column in Arcs.—The fresh conceptions introduced by Dr. Langmuir into discharge tube theory have led to such conspicuous advances within the last six years that instances in which they are inadequate are liable to be overlooked. These are of course significant in themselves, and the main outstanding one has been examined by Dr. Langmuir and Mr. L. Tonks in a paper on the general theory of the plasma—essentially the positive column—of an arc, in the second September issue of the *Physical Review*. The difficulty in question was that discrepancies arose from the obvious assumption that the positive ions, like the electrons and unionised gas-molecules, possessed random velocities and an equivalent temperature. This is now replaced by the assumption that each ion starts from rest, and merely acquires energy in the electric fields in the tube ; for long free paths, the motion of the ions is thus more ordered than in the older picture. Mathematical elaboration of this, with approximations appropriate to the physical problems, then leads to solutions for the spatial distribution of potential in some important cases, and by the further development and incorporation of some allied ideas, a set of equations is arrived at which, apart from incomplete knowledge of some factors of an atomic nature, determines completely the conditions in the positive column. A final note by the authors touches upon the stability of arcs, and here, without yet obtaining a solution, they indicate the lines upon which one will probably be reached. The same number of the *Physical Review* also contains a paper by E. Z. Stowell and H. E. Redeker, on the rôle of hydrogen in the oscillating arc.

Structural Steels of High Elastic Limit.

THE demand for stronger, but still relatively cheap, steels in shipbuilding, and in bridge and boiler construction, etc., gives considerable importance to a paper on the subject recently presented by J. A. Jones to the Iron and Steel Institute.

It is well known that it is possible to increase the elastic limit and tensile strength of the steel by an increase in the carbon content, but a comparison of steels with identical maximum strengths shows that this method of securing high-tensile properties is much less satisfactory than by increasing the amount of manganese present. A higher carbon steel, with a given maximum strength, has a lower elastic limit, yield point, and elongation, and a much lower impact value than a lower carbon steel of similar tenacity obtained by the addition of more manganese. Its fatigue range is also lower than that of a low-carbon high-manganese steel, and it is, further, much more affected by slight departure from the most suitable conditions of normalising.

The improvement in the properties of these steels by the addition of manganese is very marked, but the amount present must be limited to a figure which varies with the carbon content. With 0·2 per cent of carbon, a suitable maximum percentage of manganese is 1·8 per cent, which falls to 1·5 per cent when the carbon content is increased to 0·35 per cent. These figures apply particularly to sections $\frac{3}{4}$ in. thick; the limits of manganese content being rather lower for thinner sections. A small amount of nickel increases the ductility of low carbon steels, but at least 3 per cent of this element is required to produce a steel belonging to the high elastic limit class, and it is suggested that the use of a small amount of chromium at a lower cost would appear to be more promising.

The influence of silicon in raising the elastic limit and tensile strength of mild steel has been known for a long time, and much interest has been shown in Germany lately in a steel containing about 0·1 per cent of carbon, 0·5 to 1·5 per cent of manganese, and 0·6 to 1·5 per cent of silicon. The tensile strength of this material is from 30 to 35 tons per square inch, but with a higher carbon content, increased tenacity may be obtained. The test results given show clearly that silicon raises the fatigue range and the ratio of the fatigue limit to the tensile strength to a greater extent than does manganese. With a silicon content of 1·5 per cent, however, a marked lowering of the impact figure occurred, and no silicon steel was found with all-round properties superior to those of a plain manganese steel containing 1·5 per cent of that element. Further, the higher silicon steels present certain difficulties in manufacture. The steel pipes deeply, involving a high percentage of discard, higher temperatures are required for annealing and rolling, and greater care must be exercised in reheating, in order to avoid cracks.

Owing to these difficulties in the production of silicon steel on a large scale, a new structural steel is being developed, containing approximately: carbon 0·15 to 0·18, silicon 0·25, manganese 0·8, copper 0·5 to 0·8, and chromium 0·4 per cent. The amount of scrap produced is small, and in spite of the additional cost of the special elements, the steel can be produced more economically, and with more reliability than can the silicon steel. It has a lower tensile strength than the steels considered in Mr. Jones's paper, but an increase in the carbon with an adjustment of the copper and chromium contents might lead to the development of a high quality steel with a high limit of proportionality and good ductility.

On the whole, it is concluded that of the materials examined a steel containing 0·3 per cent of carbon, 1·3 per cent of manganese, and 0·9 per cent of silicon yields the best mechanical properties. Normalised at 860° C., this steel gave the following test results:

Elastic limit	26·8 tons per square inch.
Yield point	29·8 „ „ „ „
Maximum stress	45·6 „ „ „ „
Elongation	30 per cent.
Reduction of area	63 „ „
Brinell hardness	200
Izod impact value	44 ft.-lb.

F. C. T.

Scientific Uses of Gramophone Records.

THIRTY years ago, the possible use of gramophone records in phonological studies was realised and discussed at a meeting of the Vienna Academy of Sciences. Since then, large collections have been formed of records of all the European languages and dialects and of the speech and music of many of the primitive peoples. In archives are preserved at Vienna some 3000 records, at Paris 4000, at Berlin 10,000, and collections of similar size are to be found at important centres in all parts of the world. The first use of gramophone records in the exact sciences was in a rather premature attempt to analyse the physical nature of vowel sounds. Enlarged tracings of the grooves were obtained by a lever system from the slowly rotating record and were assumed to represent the original sounds.

Until quite recently no systematic research had been carried out upon the gramophone, but during the last few years the new electro-mechanical acoustics has been applied and has made possible the preparation of records of special value for many electrical and acoustical laboratory measurements and experiments. The Parlophone Co. has issued a set of three sound test records[1] prepared under the direction of Drs. E. Meyer and H. Salinger, of the Hertz Institute, Düsseldorf. The first record gives on one side when rotated at a speed of 80 revolutions per minute an almost pure sine wave output beginning at a frequency of 6000 and steadily gliding down to 100 Hertz (1 Hertz = 1 vibration per sec.). To overcome the difficulty of the stationary waves set up when such a record is used to obtain acoustical response curves with fixed apparatus in an ordinary room, the other side of the record is prepared to give a 'gliding howling' tone the frequency of which varies about 10 times per second by ±50 cycles, whilst the mean frequency decreases as before steadily from 6000 to 150 cycles. The system of nodes and antinodes in the room is, therefore, continually shifting. The other records of howling tones give a frequency band which is traversed about 10 times per second, whilst the mean frequency remains constant at a selected one of eight possible values.

The Gramophone Co. (H.M.V.) also issues a list of fifteen double-sided 12-in. constant frequency records, which, when rotated at a speed of 78 revolutions per minute, are capable of giving any one of 100 different frequencies of 50 seconds duration, of which the lowest is 25·5 and the highest 8460 cycles. Many possible uses of these special records are indicated in the technical press, the Parlophone Co.'s leaflet,

[1] Sound Test Records. Three 12-in. d.s. with album and instructions. Obtainable only from Parlophone Co., Ltd., 85 City Road, E.C.1. 12s. net.

and in certain German publications referred to therein. In general terms one may say that, provided the records are used with carefully designed apparatus, they are capable of forming an inexpensive standard source of either acoustical or electrical vibrations over the very wide frequency range of some eight and a half octaves.

In conclusion, it may be noted that in the ordinary commercial electrical record now made to be played upon a mechanical gramophone, the grooves represent fairly accurately the original sound over a frequency range from 60 to 6000 vibrations per second, and especially so over the range from 200 to 4000 vibrations per second. This achievement is largely due to the comprehensive acoustical researches carried out in the Bell Telephone Laboratories, New York, and details will be found in the important paper by Maxfield and Harrison, "Methods of High Quality Recording and Reproduction of Music and Speech based on Telephone Research" (*Jour. Am. Inst. El. Engineers*, **45**, pp. 243-253; 1926).

W. H. GEORGE.

Marine Biology in Ceylon.

THE Administrative Report of the Marine Biologist for 1927, Part IV. Education, Science, and Art (F.), by Dr. Joseph Pearson, November 1928, Ceylon, includes reports by the assistant marine biologist on the pearl fishery, Gulf of Mannar; window pane oyster fishery; chank fishery and trawling survey with statistics, and by the second assistant marine biologist on field and laboratory work with notes on fishes and fishery problems. The work was done under the supervision of the marine biologist, Dr. Joseph Pearson, who contributes the introduction and reports on the research vessels *Nautilus* and *Violet*, with suggestions for suitable fishery vessels and a fishery base.

The report on the pearl fishery is very interesting, showing how quickly conditions change, and that whereas in 1926 in Donnan's Muttuwarattu Paar, which was specially investigated, the oysters were much on the decrease, in the spring of 1927, owing to supplementing of the original stock by drift oysters, they were in much greater numbers, again decreasing in the autumn. A discussion relative to the age of these oysters shows that they seldom live so long as five years, and that they should be fished at three and a half years on this particular paar, and probably on others. This is a very low age estimate compared with that of previous workers.

The chank fishery is apparently peculiar in that there is no substantial diminution in the yearly yield however much it is fished. No details are known with regard to the rate of growth and habits of this animal, and more research is needed.

The important and valuable fishing banks known as the Pedro and Wadge Banks up to 1927 had no charts of any kind. The trawling survey was begun in August 1927, and a Petersen grab is on order for bottom sampling. The figures for the analysis of the trawls are not quite correct, but an average of 207 fish per hour is taken as a low estimate, only fish of first-class edible quality being included. Assuming 20 hours trawling per day, this would give a daily catch of 4140 lb., or approximately 36 cwt. A much larger average is probably possible. Two important features are (1) that the catches are made up of a restricted number of species, which are of a convenient size both for storage and for market, and are equal in edible qualities to any tropical fish now marketed, and (2) there is very little waste. *Lethurus* (sea bream) comes first in numbers, 29 per cent, and *Lutianus* (snapper) second, 23 per cent.

The trawling investigations made by the Department in the seas around Ceylon are promising, particularly on these two banks described. These are the only trawling grounds so far discovered in Indian waters which show promise of successful exploitation. A fish-trawling company was floated in 1926, and during the year under review the company laid down one trawler which was expected to arrive in Ceylon about the middle of 1928. Twenty-seven per cent of the capital of this company has been subscribed by the Sinhalese.

It is a difficult matter to devise suitable boats for the inshore fishermen. This problem is now under consideration.

Much more research is needed into the economic problems, especially on the habits and life-histories of the principal food fishes, and there is abundant room for many more workers.

Theoretical Investigations of Ocean Currents.

THE mathematical investigations of Prof. V. W. Ekman into the dynamics of ocean currents have been directed chiefly to the study of 'type problems'; in these, friction is taken into account, but simplifying assumptions are made as to differences of density, the extent of the field, etc., so that his methods do not lead to quantitative results. He has now given us a non-mathematical account of his later work ("A Survey of Some Theoretical Investigations of Ocean Currents." *J. du Cons. Perm. Internat. pour l'Exploration de la Mer*, **3**, No. 3, p. 295, 1928), in which he shows what modification of his earlier results is necessary.

Starting from the well-known pseudo-force due to the rotation of the earth, which acts on a moving particle directly as its mass and velocity if the latitude is constant, he shows that, conversely, a particle which is acted upon by a constant force and is not otherwise constrained, will move at right angles to the force *cum sole*; its velocity, the 'normal velocity', and not the acceleration, will vary directly as the force. The original theory of the 'pure drift current' is modified by no longer assuming that the 'coefficient of virtual viscosity' is invariable, but no important change results; the spiral is still developed, but it is no longer equiangular, and the angle of surface deflection is not exactly 45°. Unlike the drift current, a slope current extends to the bottom, so that it is necessary to assume a layer in which bottom friction is effective; its thickness is the 'lower depth of frictional influence', corresponding with, but not equal to, the 'upper' depth. It is only in this lower layer that any transport of water in the direction of the slope takes place.

Out of this arise Prof. Ekman's recent investigations into the 'deep current' which lies above the bottom layer, and the effect on it of the topography of the bottom. A deep current running in the direction of increasing depth will experience a rotation *contra solem*. Further, since the velocity of the deep current increases from the pole to the equator, it will experience a rotation *cum sole* when directed towards increasing latitude.

These conclusions require some modification, the

mount of which is not quite certain. They depend upon the neglect of the acceleration of the current, which is not justifiable during the first few hours after the establishment of a slope, but they may be summed up as follows: A deep current tends to follow the parallels of latitude in low latitudes and the contour lines of the bottom in high latitudes. If the bottom topography is irregular, the current will tend to turn *contra solem* when running towards deeper water, and *cum sole* when the flow is towards smaller depths.

In conclusion, it is shown that convection currents may be discussed in some cases by the method of type problems. They are largely confined to the upper layers, so that we may assume a homogeneous deep layer on which the currents of the upper layer act as the winds act upon the surface of the sea, through the medium of a separating layer for which the name 'internal drift current' is proposed.

University and Educational Intelligence.

CAMBRIDGE.—E. G. Williams, of Trinity College, has been elected to an Isaac Newton Studentship, and F. L. Arnott, research student of Trinity College, has been elected to an additional Isaac Newton Studentship.

P. I. Dee, Taylor Research Fellow of Sidney Sussex College, has been elected to the Stokes Studentship at Pembroke College.

The degree of Sc.D. (*honoris causa*) has been conferred on Sir James Alfred Ewing, formerly professor of mechanism and applied mechanics in the University and until recently Principal and Vice-Chancellor of the University of Edinburgh.

EDINBURGH.—At the meeting of the University Court on Oct. 28, intimation was made of a benefaction by Mr. T. B. Macaulay to the Department of Animal Genetics. The endowment will provide an income of about £1100 a year, which is to be used for the provision of salaries for a special lectureship (the Macaulay lectureship) and associated assistantships. Mr. Macaulay has given a further sum of £1000 a year for the next five years toward the cost of researches of this group, and has offered to contribute £5000 for the purchase of a farm for the Department. The Court has expressed its appreciation of this latter proof of Mr. Macaulay's valued and helpful interest in the Department, and a special sub-committee has been called into being for the purpose of seeking full information as to the additional commitments that must be undertaken if a farm should be acquired.

Mr. Macaulay, the president and managing director of the Sun Life Assurance Company of Canada, has done much for the island of Lewis, the home of his forebears, having endowed a hospital and library, a peat research farm, and an educational trust. More recently he has endowed a soils research institute in Aberdeen.

GLASGOW.—At a meeting of the General Council of the University on Oct. 30, Sir Donald MacAlister was unanimously elected Chancellor in succession to the late Lord Rosebery. The University is thus to be congratulated upon retaining in high office one who has rendered it splendid services during his long tenure of the principalship. Since the middle of the seventeenth century the holder of the office of chancellor has always—except during a short break between 1875 and 1878—been a peer either temporal or spiritual, but apart from mere titular rank it will be felt that the new Chancellor is no unworthy successor to the long line of distinguished men who have previously held this office, including as his immediate predecessors Kelvin and Rosebery.

The office of Principal, vacated by Sir Donald MacAlister, has now been filled by the appointment of Prof. R. S. Rait, and the appointment is viewed with much pleasure by his numerous friends within and outside the University. Principal Rait, a former fellow and tutor of New College, has occupied since 1913 the chair of Scottish history and literature and is also Historiographer-Royal for Scotland. In addition to being president of the Senatus Academicus, the principal of a Scottish university becomes also in practice the chairman of the governing body or University Court, as the rector, its official president, is usually non-resident. The new principal has thus before him great responsibilities, but his task will be rendered lighter through the affairs of the University being handed over to him by one who is commonly regarded as the most able university administrator of our time.

LONDON.—The Senate, with the concurrence of the Court, has appointed Dr. Edwin Deller, previously Academic Registrar in the University, to the post of Principal of the University as from Oct. 1, 1929, in succession to Dr. T. Franklin Sibly, now Vice-Chancellor of the University of Reading.

THE seventeenth election to Beit Fellowships for scientific research, tenable at the Imperial College of Science, will take place on or about July 15, 1930. Not more than three Fellowships will be awarded, each of the annual value of £250. Candidates must be of European descent and less than twenty-five years of age at the time of election. Applications must be received on or before April 15, 1930. Further information can be obtained, by letter only, from the Rector, Imperial College, South Kensington, London, S.W.

EDUCATIONAL experiment and research in tropical and sub-tropical areas will be stimulated, encouraged, guided and rendered increasingly efficacious by a new journalistic venture of the Colonial Office. On Oct. 24 appeared the first number of *Oversea Education*, a quarterly journal published for the Secretary of State for the Colonies by the Oxford University Press (1*s*. Annual subscription, 4*s*.). Although produced primarily for the benefit of the Colonies, it will appeal to and draw material from all countries where education is studied in a scientific spirit. This first number includes articles on methods of compulsory education in the Tonga Islands, village schools in Palestine, the educational work of the Empire Marketing Board, and the development of indigenous arts and crafts (by Prof. Rothenstein), a vivid personal narrative by a native graduate of one of the 'Jeanes' schools established by Colonial governments in Kenya, Nyasaland, and Northern Rhodesia for the training of selected village school teachers as missionaries of rural culture, notes on bilingualism in Wales, recommendations relating to rural education from the report of the Royal Commission on Agriculture in India, 1928, Mr. J. L. Sibley's work in Liberia, proposals for unifying the scripts of the 743 languages and dialects of India, and the visual instruction work of the Royal Empire Society's Imperial Studies Committee. It has also reviews by competent authorities of books on educational developments in Africa, India, and Ceylon. "Rural Science", a handbook for teachers in Ceylon schools, reviewed by Mr. R. H. Stoughton, formerly Mycologist, Rubber Research Scheme, Ceylon, illustrates the new government policy of giving a rural bias to the entire educational system of the island. An introductory article is contributed by the Right Hon. W. Ormsby Gore. The journal can scarcely fail to accomplish by publicity and co-ordination of effort a notable advance towards the objects for which it has been instituted.

Calendar of Patent Records.

November 11, 1847.—The discovery that coal-tar contained benzene was made by A. W. Hofmann, but the production of benzene from coal-tar on a commercial scale was due to Charles Blackford Mansfield, a pupil of Hofmann's, and dates from the patent granted to him on Nov. 11, 1847, for "An improvement in the manufacture and purification of spirituous substances and oils applicable to the purposes of artificial light and various useful arts". Mansfield died as a result of burns received whilst he was carrying out some of his experiments on tar.

November 11, 1896.—The Bowden wire method of transmitting motion, so widely used in connexion with the operation of brakes and other parts of bicycles, was the invention of E. M. Bowden and was patented by him on Nov. 11, 1896.

November 12, 1673.—The patent granted to William Chamberlayne on Nov. 12, 1673, for his "new art or mistery of plating and tynninge of iron, copper, steele, and brasse, and for the compressing and plateing of all other mettalls; hee never yett useing or putting them in practize by reason of his long imprisonment and troubles in the late intestine warrs and since", was a confirmation of a previous grant made in 1661 to Chamberlayne and Dud Dudley. Chamberlayne did not put his invention into practice, and the patent is referred to by Andrew Yarranton in his "England's Improvement" as one which obstructed the introduction of the tin-plate industry into England from Saxony, which he had visited to obtain knowledge of the process of manufacture employed there. The industry was not established here until the beginning of the eighteenth century.

November 12, 1723.—On Nov. 12, 1723, a patent was granted to Ambrose Godfrey, a chemist at one time employed by Robert Boyle, for a new method of extinguishing fires. He used "a small portion of gunpowder closely confined; which when animated by fire acts by its elastic force upon a proper medium and not only divideth it into the minutest atoms but disperseth it also in every direction so as immediately to extinguish any fire within a certain distance. This medium is a liquor strongly impregnated with a preparation of antiphlogistic principles." A test of Godfrey's invention was successfully made before the Society of Arts on a house built for the purpose in Tottenham Court Road.

November 13, 1800.—The method of making cast steel by melting malleable iron with charcoal or other carbonaceous material in a crucible was first used in Sheffield by David Mushet, who patented the process on Nov. 13, 1800. Mushet was the first practical man in England to write on the manufacture of iron and steel.

November 14, 1835.—Joseph von Hohenblum was granted an Austrian patent on Nov. 14, 1835, for a system of pneumatic dispatch for postal packets, the letters being placed in small cylinders which were to be carried through long tubes by compressed air. The first successful installation of such a system was, however, first made in London about 1853.

November 15, 1747.—The famous fever powders of Dr. Robert James, "sold, wholesale and retail by John Newberry, bookseller, at the Bible and Sun, in St. Paul's Churchyard", were patented by James on Nov. 15, 1747. Patronised by Royalty, recommended by Horace Walpole, and its praises sung by the poets, nearly three million doses, Dr. James tells us, of the powder had been sold or distributed by 1764. In 1753 the Privy Council were petitioned to vacate the patent on the ground that the invention had been obtained from a Baron Schwanberg, but the petition was refused.

Societies and Academies.

LONDON.

Geological Society, Oct. 23.—**R. D. Oldham**: Historic changes of level in the delta of the Rhone. (1) At the opening of the Pleistocene period the whole area was covered by a deposit of gravel and well-rounded boulders, over which the Rhone and its tributaries wandered, with no fixed bed and with a velocity of current that gave them a torrential character. (2) A period of subsidence followed, the gradient and the speed of current were diminished, and an alluvial delta built up, which was at least as extensive as that of the present day. Two stages can be recognised in this deposit. (3) A period of uplift then set in, and the land rose, not less than 14 metres, above the level to which it had sunk, the deposits laid down were exposed to denudation, and an undulating surface of erosion was developed. On this weathered surface the settlements and structures of the Romans were erected. (4) Finally came another period of subsidence, which took place at intervals. One of these periods of subsidence probably took place between the years 1000 and 1500 B.C. The next change took place in the course of the eighth and ninth centuries; it amounted to about 5 metres of vertical displacement. Finally, there was a fresh movement of subsidence, practically completed during the later half of the eighteenth century. The total amount of these movements of subsidence was about 10 metres, and at the end of them the land still stands about 4 metres, or more, above the lowest level reached before the period of uplift set in.—**R. W. Pocock**: The *Petalocrinus* Limestone horizon at Woolhope (Herefordshire). The crinoid *Petalocrinus* has been recorded from Sweden and North America, but not hitherto from Britain. Its most striking peculiarity is the fusion of the arms into five solid arm-fans or petals, which radiate from the dorsal cup. The arm-fans are usually found detached in the limestone, throughout which they are profusely scattered. A bed of large tabulate corals on which the *Petalocrinus* band rests is found in this association throughout the outcrop. The combined thickness of the crinoid and coral-beds varies between 3 in. and 6 in. Llandovery rather than Wenlock affinities are indicated by the fauna of the transition-beds. The area appears to have been subjected to pressure, mainly along a north-west and south-east axis, developing thrust-faulting approximately at right angles to that axis; a late Coal Measure age is suggested for the principal movements. At May Hill and at Malvern the *Petalocrinus* Limestone with its associated coral-beds has been detected at the same horizon as at Woolhope.—**P. K. Ghosh**: The Carnmenellis granite: its petrology, metamorphism, and tectonics. This granite, which occupies an area of some 50 square miles between Falmouth and Camborne (Cornwall), was divided by the Geological Survey into (1) an earlier coarse variety and (2) a later fine variety. The coarse granite of the Survey has been subdivided into three types, which prove to be three distinct intrusions. The petrological characters of the granites and their differentiates are described. Analyses have also been made of the associated metamorphic rocks; these consist of 'green-stones', slates, and schists of various types, as well as inclusions of country-rock within the granite.

PARIS.

Academy of Sciences, Sept. 9.—**E. Fichot**: The waves of Poincaré in a winding canal.—**Paul Vuillemin**: Mycoses of the epidermis. The author distinguishes

two types of mycosis, hyphomycoses and brachymycoses, and gives examples of each type.—Ed. Chauvenet and J. Davidowicz: Zirconium iodide, zirconium oxyiodide hydrate, $ZrOI_2.8H_2O$, prepared by the evaporation of the solution of hydrated zirconia in hydriodic acid, gives the volatile compound H_2ZrI_6 on heating. The latter decomposes on heating into HI and ZrI_4. The tetraiodide can also be prepared by the direct interaction of the metal (95 per cent Zr) and iodine at a red heat.—Ph. Joyet-Lavergne: An experimental demonstration of the laws of cytoplasmic sexualisation.

Sept. 16.—H. Deslandres: The magnetic field of the sun, general and external. A discussion of work done at the Mount Wilson Observatory, and of communications by Chapman and by Evershed, with reference to the author's work on the magnetic fields of the sun since 1911.—Marin Molliard: The physiological characters presented by *Sterigmatocystis nigra* when lacking zinc and iron. The omission of iron and zinc from the culture medium of this mould causes much slower development, and this is connected with the production of citric acid and of soluble starch. It could not be definitely settled whether these two metals were absolutely indispensable for growth.—A. Desgrez and P. Régnier: The experimental study of the action of Evian water in cases of induced nephritis.—N. Lusin: The points of unicity of a measurable ensemble *B*.—B. Lyot: The polarisation of the planet Mercury.—Mlle. L. S. Lévy: The probable rôle of the complex ammonia compounds in the adsorption of copper and nickel salts by ferric hydroxide.—Mme. N. Demassieux: The action of the alkaline carbonates on lead bromide, iodide, and nitrate in aqueous solution. The iodide and bromide resemble the chloride in forming precipitates of lead bromocarbonate and lead iodocarbonate when alkaline carbonate is gradually added. Lead nitrate behaves differently, lead carbonate being the only product.—J. Vellard and Miguelotte Vianna: Modifications of the blood coagulation in the course of experimental yellow fever in *Macacus rhesus*. The results resemble those obtained with man. The modifications of the blood coagulation are of the same nature, but less accentuated and slower in the ape.

Sept. 23.—Rodolphe Raclis: A formula of summation.—Akitsugu Kawaguchi: The different connexions of functional space.—Krawtchouk: The approximate solution of linear differential equations.—Mlle. Nina Bary: Functions possessing the *N* property.—Georges Durand: The Cantor-Minkowski construction in space.—Georges Bouligand: Problems connected with the idea of the Georges Durand envelope.—M. Gunther: An application of the integrals of Stieltjes to the problem of Neumann.—Alfred Rosenblatt: On certain plane stationary movements of incompressible viscous fluids.—R. Mazet: An empirical formula giving the distribution of the yield at the surface of a circular orifice.—A. Auric: An empirical formula giving the distances at which the successive rings of the nebular hypothesis are formed.—P. Marti: The submarine volcanic region of the Catwick Islands.—Takeuchi: The average force exerted by the stationary vibration of a string on a ring through which the string passes.—G. Athanasiu: The influence of temperature on the photovoltaic electromotive forces. All the photoelectric cells studied showed an increase in the electromotive force when the temperature fell. The magnitude of the temperature coefficient proved the impossibility of explaining photovoltaic currents by identification with external photoelectric emission.—J. Perreu: The determination of the heats of dilution of hydrated salts (second method).—R. Levaillant: The conversion of alkyl sulphites into chlorsulphonic esters and into the neutral sulphates. The alkyl sulphites, treated at low temperatures with chlorine, give good yields of the corresponding chlor-sulphonates. At high temperatures the latter react with alkyl sulphites, giving nearly quantitative yields of the sulphates.—Hans Fischer and Albert Kirrmann: The synthesis of some mesoporphyrins.—Henri Mémery: The summer of 1929 and the solar variations. The sustained high temperatures during August and September of this year correspond with a marked increase in the number of sunspots during the same period.—Peirier: The Caloncoba, from the Cameroons, giving an oil with curative properties against leprosy.

Vienna.

Academy of Sciences, June 13.—H. Przibram and L. Brecher: Growth measurements of *Tenodera aridifolia*, a Japanese mantis. There are eight or exceptionally nine changes of skin. The fasting weight was doubled after the seventh, eighth, and ninth moults. Successive cast-off skins are about double in weight.—A. Brukl: The quantitative analysis of gallium (3). Titanium is precipitated free from gallium from an oxalic acid solution by means of copper. Larger quantities of titanium with zirconium are precipitated by phenyl-arsenic acid. Oxyquinolin separates gallium from vanadium.—A. Kailan and K. Hexel: Velocity of esterification of mono-brom-acetic acid with glycerinic and ethyl-alcoholic hydrochloric acid.—W. J. Müller and K. Konopicky: The theory of passivity effects (6). The passivity of chromium at low current densities.—E. Schrenzel: Curves with isotropic normals.—J. Pollak, E. Gebauer-Fülnegg, and E. Blumenstock-Halward: β-naphthol-disulphochlorides.—J. Pollak and E. Riess: Oxythiophenols (2).—E. Gebauer-Fülnegg and A. Glückmann: α-naphthol-sulpho-acids.—E. Riess and R. Hübsch: Some new thiazol derivatives.—C. Drucker: Experimental contributions to the problem of electrolytic dissociation.—C. Marie and G. Lejeune: The solubility of ether in concentrated solutions of some mineral acids.—F. Skaupy: Grain limit and grain magnitude, their importance for some scientific and technical questions.—F. Kaufler: Crotonic acids.—O. Fürth and H. Kaunitz: The oxidation of some physiological substances by animal charcoal.—N. Fröschl and J. Zellner: Fungus resins.—E. Dittler: The degrees of oxidation of titanium in silicates. In titaniferous silicates a part or the whole of the titanic acid can be replaced by the next lower oxide of this metal. By synthesis it was shown that in silicates not only silicic acid but also the sesquioxide to a considerable extent may be replaced by TiO_2 or Ti_2O_3 respectively.—K. Menger: The foundation of an axiomatic theory of dimension.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (3). Attempts to interpret the Raman spectrum.—S. Meyer: The representation of the packing effects of the atoms.

June 20.—A. Kailan and W. Antropp: The esterification velocities of chloro- and fluoro-benzoic acids, of phthal-ethyl-esteric acid and abietinic acid with ethyl-alcoholic hydrochloric acid.—A. Haas: The deduction of Boltzmann's law of entropy by means of the concept of matter-waves.—G. Horvath: Rhyncotes from Palestine and Syria.—K. Lohberger: More fish from the Thian-Shan.—K. Lohberger: Some still undescribed fish forms from the Thian-shan.—A. Soltys: Iosene, a new hydrocarbon from Styrian brown coal. Formula $C_{20}H_{34}$, melting point 74°.

— A. Soltys: Three compounds extracted from Styrian brown-coal with petrol-ether: a compound, $C_{30}H_{50}O$, melting point 256°, and a fluid, $C_{15}H_{26}$, boiling point 265°. — R. Weiss and J. Reichel: Triphenyl-methanes, the benzene nuclei of which are interconnected (5). The di-methylene-triphenyl-carbinol-diketone. — L. Mirskaja: Repair processes in longitudinally split stems of *Mirabilis Jalapa*. —W. Feldmann: The growth of the stem parts in *Phaseolus coccineus* seedlings with the primordial leaves cut off or kept in the dark. Either process and likewise the reduction of the carbon dioxide content of the atmosphere leads to an increase in the growth of the stem.—A. Kailan: Chemical actions of penetrating radium radiations (18). The action on acetyl- and benzoyl-chloride. Considerable changes of specific conductivity are probably due to secondary reactions.—L. Kober: Contributions to the geology of Attica.

Official Publications Received.

BRITISH.

Ministry of Health. Advisory Committee on Water: Second Report of Legislation Sub-Committee. Pp. 82. (London: H.M. Stationery Office.) 9*d*. net.

North-East Coast Institution of Engineers and Shipbuilders (Incorporated), Bolbec Hall, Newcastle-on-Tyne. Report of the Council, 1928–9. Pp. 18. (Newcastle-on-Tyne.)

Journal of the Royal Society of Western Australia. Vol. 13, 1926–1927. Pp. xvi+88+29 plates. (Perth.) 25*s*.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 8-9, August–September 1929. Abstracts Nos. 1561-1982. Pp. v+287-350. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

University College of North Wales. Calendar for Session 1929–30. Pp. 392. (Bangor.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on October 17th, 1929. Pp. 8. (London.)

Nickel Steel, Series A, No. 3: Nickel Alloy Steels in High Performance Internal Combustion Engines. By T. Henry Turner. Pp. 12. (London: The Bureau of Information on Nickel, Ltd.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 30th October 1929. Pp. 41. (Newcastle-upon-Tyne.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1929; with Report of the Director of Fuel Research. Pp. viii+127. (London: H.M. Stationery Office.) 2*s*. net.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 14, Parts 3 and 4, 14 October. Pp. 181-335. (Cambridge: At the University Press.) 15*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1246 (Ae. 399): Measurement of Landing Loads. By E. T. Jones. (T. 2779.) Pp. 8+5 plates. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Institution of Great Britain. Vol. 26, Part 1, No. 123. Pp. 134. (London.) 10*s*. 6*d*. net.

Indian Statutory Commission. Interim Report of the Indian Statutory Commission (Review of Growth of Education in British India by the Auxiliary Committee appointed by the Commission), September 1929. (Cmd. 3407.) Pp. xxxiii + 401. (London: H.M. Stationery Office.) 4*s*. net.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1928. Pp. vi+110. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1928–29. Pp. 42. (London.)

India Meteorological Department. Scientific Notes: Vol. 1, No. 4: On Temperatures of Exposed Rails at Agra. Note prepared by Dr. K. R. Ramanathan. Pp. 37-48. 8 annas; 10*d*. Vol. 1, No. 5: Frequency of Thunderstorms in India. Pp. 49-55+1 plate. 6 annas; 8*d*. Vol. 1, No. 6: Correlations between Pre-Monsoon conditions over North-West India and subsequent Monsoon Rainfall over North-West India and the Peninsula. By Rao Saheb Mukund V. Unakar. Pp. 57-67. 6 annas; 9*d*. (Calcutta: Government of India Central Publication Branch.)

Colony and Protectorate of Kenya. Forest Department Annual Report, 1928. Pp. 32. Forest Department Pamphlet No. 2: The Influence of Forests on Climate and Water Supply in Kenya. By J. W. Nicholson. Pp. 40. (Nairobi.)

Oversea Education: a Journal of Educational Experiment and Research in Tropical and Subtropical Areas. Vol. 1, No. 1, October. Pp. 32. (London: Oxford University Press.) Quarterly, 1*s*.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 40, Part 3, 22nd October. Pp. 197-306. (London: Edward Stanford, Ltd.) 5*s*.

University of London: University College. Calendar, Session 1929–1930. Pp. 18+lxxx+493+lxxxi-ccviii+19-36. (London.)

Board of Education. Report on the Science Museum for the Years 1927 and 1928. Pp. 35. (London: H.M. Stationery Office.) 1*s*. net.

Canada. Department of Mines: Mines Branch. Comparative Tests of various Fuels when burned in a Domestic Hot-Water Boiler. By E. S. Malloch and C. E. Baltzer. (No. 705.) Pp. v+92+5 plates. (Ottawa: F. A. Acland.) 20 cents.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929. Vol. 41, October. Pp. 621-685. (London.)

Proceedings of the Liverpool Geological Society. Session the Seventieth 1928–1929. Part 2, Vol. 15. Edited by C. B. Travis. Pp. xiii+111-178+plates 3-7. (Liverpool.)

Some Problems of the Medical Profession in India. Compiled by Kumud Sankar Ray. Pp. vii+88. (Calcutta: All-India Medical Association.)

Journal of the Indian Institute of Science. Vol. 12A, Part 9: The Activated Sludge Process of Sewage Treatment; Report on the Working of the Plant at the Indian Institute of Science, Bangalore. By N. Swaminathan. Pp. 131-151. 1.4 rupees. Vol. 12A, Part 10: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.), Part 6: Nitrogen Metabolism in Healthy and Spiked Sandal Leaves. By N. Narasimhamurthy and M. Sreenivasaya. Pp. 153-163. 12 annas. Vol. 12A, Part 11: Lengthened *Ortho*-Di-Derivatives of Benzene and their Ring-Closure; Formation of Polymembered Heterocyclic Compounds from Substituted Phenylene-Dicarbamides. By Tejendra Nath Ghosh and Praphulla Chandra Guha. Pp. 165-178. 12 annas. Vol. 12A, Part 12: Oil from the Seeds of *Sapinus trifoliatus* (Linn.). By D. R. Paranjpe and P. Ramaswami Ayyar. Pp. 179-184. 6 annas. (Bangalore.)

Ceylon. Administration Report of the Director of the Colombo Museum for 1928. By Dr. Joseph Pearson. Pp. F16 + 7 plates. (Colombo: Government Record Office.) 70 cents.

Memoirs of the Geological Survey of India. Vol. 52, Part 2: The Aluminous Refractory Materials; Kyanite, Sillimanite and Corundum in Northern India. By Dr. J. A. Dunn. Pp. iv+145-274+xxi+plates 15-27. 5.8 rupees; 9*s*. Palaeontologia Indica. New Series, Vol. 10, Memoir No. 3: Les couches à cardita Beaumonti. Fascicule 2: Les couches à cardita Beaumonti dans le Sind. Par Prof. Henri Douvillé. Pp. iv+27-73+plates 5-11. 4.8 rupees; 7*s*. 6*d*. (Calcutta: Government of India Central Publication Branch.)

Gold Coast Colony. Report on the Survey Department for the Financial Year 1928–1929. Pp. ii+27. (Accra: Government Printing Office; London: The Crown Agents for the Colonies.) 2*s*.

Nigeria. Annual Report on the Agricultural Department for the Year 1928. Pp. 24. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2*s*.

FOREIGN.

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 24, Part 4: Physico-chemical Investigation on the Casein-splitting Action of Papain with Special Reference to the Fundamental Properties of its Action as well as to the Mechanism of the Acceleration of HCH Solution upon its Action. By Shōichi Satō. Pp. 101-151. (Tokyo: Maruzen Co., Ltd.)

University of Illinois Engineering Experiment Station. Bulletin No. 194: Tuning of Oscillating Circuits by Plate Current Variations. By Prof. J. Tykocinski-Tykociner and Ralph W. Armstrong. Pp. 51. (Urbana, Ill.) 30 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 18, No. 15: Drepania, a Genus of Nudibranchiate Mollusks new to California. By F. M. MacFarland. Pp. 485-496+plate 35. Vol. 18, No. 16: Some Upper Cretaceous Foraminifera from near Coalinga, California. By J. A. Cushman and C. C. Church. Pp. 497-530+plates 36-41. (San Francisco.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 11, Livraison 1, Août. Pp. 153. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Instituto Nacional de Investigaciones y Experiencias Agronómicas y Forestales. Boletin Núm. 3: Instituto Forestal de Investigaciones y Experiencias; Trabajos de la Secciones hidráulica torrencial, combustibles vegetales, flora y mapa forestal, resinas. Pp. 142. (Madrid.)

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 45: Thirteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey of Connecticut, 1927–1928. Pp. 32+3 plates. 10 cents. Bulletin No. 46: The Physical History of the Connecticut Shoreline. By Henry Staats Sharp. Pp. 97+8 plates. 75 cents. (Hartford, Conn.)

Report of the National Committee on Calendar Simplification for the United States, submitted to the Secretary of State, Washington, August 1929. Pp. 119. (Rochester, N.Y.: National Committee on Calendar Simplification.)

Travaux de la Section de Géodésie de l'Union Géodésique et Géophysique internationale. Tome 6: Rapports généraux établis à l'occasion de la troisième assemblée générale, Prague, 29 août-10 septembre 1927. Pp. vi+6+7+60+33+32+13+28+4+10+6+17. (Paris.)

El tunel del estrecho de Gibraltar: Conferencia pronunciada el 25 de marzo de 1929. Por Sr. D. Rafael de Buen. Pp. 29. (Madrid: Real Sociedad Geográfico.)

Masarykova Akademie Prace: Académie Masaryk du Travail. Publication scientifique 47: Conférences faites en décembre 1925 à l'Université et à l'École polytechnique de Prague par le Col. Georges Perrier. Pp. 69. (Prague.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 10, Octobre. Pp. 521-570. (Prague: Regia Societas Scientiarum Bohemica.)

Department of Commerce: Bureau of Standards. Research Paper No. 88: Some Absorption Properties of Clay Brick. By L. A. Palmer. Pp. 105-127. (Washington, D.C.: Government Printing Office.) 10 cents.

The University of Colorado Studies. Vol. 17, No. 2: Non-Marine Mollusca of Oregon and Washington. By Junius Henderson. Pp. 45-190. (Boulder, Colo.) 1 dollar.

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102: Mededeelingen en Verhandelingen, 32. Het Klimaat van Nederland. C Luchtdrukking; D: Wind. Door Dr. C. Braak. Pp. 158. (Amsterdam: Seyffardt's Boekhandel.) 1.50 f.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 192: Causes and Effects of Soil Heaving. By M. M. McCool and G. J. Bouyoucos. Pp. 11. Technical Bulletin No. 100: The Differentiation of the Species of the Genus Brucella. By I. Forest Huddleson. Pp. 16. Technical Bulletin No. 101: A Test for Water-Soluble Phosphorous; Studies on Water-Soluble Phosphorous in Field Soils. By C. H. Spurway. Pp. 25. (East Lansing, Mich.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico internationale 1900-0. Zona di Catania fra le declinazioni +46° e +55°. Vol. 6, Parte 2ª: Declinaz. da +51° a +53°, ascens. retta da 3ʰ a 6ʰ. (Fascicolo N. 42.) Pp. viii+36. L'Attività dell' Osservatorio nel 1928. Pp. 7. (Catania.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 23: American College Athletics. By Howard J. Savage and Harold W. Bentley, John T. McGovern, Dr. Dean F. Stanley. Pp. xxii+383. (New York City.) Free.

Festschrift für die 110 Jahresversammlung der Schweizerischen Naturforschenden Gesellschaft in Davos. Pp. 270+20 Tafeln. (Basel: Benno Schwabe und Co.) 9.60 gold marks; 12 Schw. francs.

Scientific Papers of the Institute of Physical and Chemical Research. No. 196: The Constituents of Matteucia Orientalis. By Shin-ichiro Fujise. Pp. 111-118. 20 sen. No. 204: Raman Effect on Organic Substances. By Yoshio Fujioka. Pp. 205-222+plates 10-16. 55 sen. No. 205: Slip-Bands of Compressed Aluminium Crystals. Part 1: Distortion of Single Slipping and a Tentative Theory of Work-hardening of Metal. By Keiji Yamaguchi. Pp. 223-241+plates 17-19. 45 sen. No. 206: Stark Effect for the Spectral Lines of Chlorine, Bromine and Iodine. By Kwan-ichi Asagoe. Pp. 243-250+plates 20-24. 35 sen. (Tōkyō: Iwanami Shoten.)

International Review of Educational Cinematograph. Year 1, No. 1, July 1929. Pp. 116. (Rome: International Educational Cinematographic Institute, League of Nations.)

Ministerio da Agricultura, Industria e Commercio: Observatorio Nacional do Rio de Janeiro. Boletim Magnetico do Observatorio Nacional, 1927 e 1928. Pp. 87. (Rio de Janeiro.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1598: Mountain Beavers in the Pacific Northwest; their Habits, Economic Status and Control. By Theo. H. Scheffer. Pp. ii+18. 5 cents. Leaflet No. 31: Termites in Buildings. By Thos. E. Snyder. Pp. ii+5. Miscellaneous Publication No. 51: National Wild-Life Reservations. Pp. 10. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 21: Industrial Education, 1926-1928. By Maris M. Proffitt. Pp. 24. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 75, Art. 19: A Revision of the Beetles of the Tenebrionid Tribe Usechini, with Descriptions of a New Genus and New Species. By Frank E. Blaisdell, Sr. (No. 2790.) Pp. 14+1 plate. (Washington, D.C.: Government Printing Office.)

Memoirs of the University of California. Vol. 9, No. 1: The Chromosomes in Man, Sex and Somatic. By Herbert M. Evans and Olive Swezy. Pp. 65 (11 plates). (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.50 dollars.

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 99: Thermoelectric Temperature Scales. By Wm. F. Roeser. Pp. 343-358. (Washington, D.C.: Government Printing Office.) 5 cents.

University Studies. Vol. 26, Nos. 1-2: Distribution and Structure of the Forests of Eastern Nebraska. By John M. Aikman. Pp. 75+19 plates. (Lincoln, Nebr.: University of Nebraska.)

CATALOGUES.

Catalogue of Optical Lanterns, Epidiascopes and other Projection Apparatus. Pp. 52. (London: Newton and Co.)

Spectrographic Outfits for Metallurgical Analyses: a Guide to the Choice of suitable Spectrographic Apparatus for a Technical Laboratory. Pp. 38. (London: Adam Hilger, Ltd.)

Catalogue of Recent Purchases of Rare, Uncommon and New Works on Botany (Horticulture, Floras, Herbals) and Zoology. (No. 10.) Pp. 20. (London: John H. Knowles.)

Diary of Societies.

FRIDAY, NOVEMBER 8.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—G. Smith: The Mildew Problem in the Cotton Industry.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. M. Green: The Indian Cinema Industry.

ASIATIC SOCIETY (jointly with Central Asian Society) (at Burlington House), at 5.—Sir Aurel Stein: Alexander's Campaigns on the North-West Frontier of India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. E. A. Milne: The Masses, Luminosities, and Effective Temperatures of the Stars.—Prof. A. S. Eddington: Internal Circulation in Rotating Stars.—Dr. H. Spencer Jones: A Revision of Newcomb's Occultation Memoir.—R. A. McIntosh: (*a*) The Meteor Swarm of Halley's Comet; (*b*) Observations of the Orionid Meteors.—Prof. A. S. Eddington and S. Plakidis: Irregularities of Period of Long Period Variable Stars.—Report of the British Expedition to Observe the Total Solar Eclipse of 1929, May 9.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. Sir C. V. Raman: Diamagnetism and Molecular Structure (Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30.—W. S. Stiles: The Nature and Effects of Glare.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Section) (at 36 George Street, Manchester), at 7.—E. M. Cass: Undue Compression in the Cylinders of Steam Locomotives and Means of Combating Same.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—H. Neilsen: Low Temperature Carbonisation of Fuel.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—J. Morris: Cotton Spinning and Doubling.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. Orme: Nickel-Silver.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. P. J. Cammidge: Retinitis in Diabetes.—T. Thomas and M. S. Mayou: Sarcoma of the Iris.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Reece's Café, Liverpool).—Dr. Fox: Some Reminiscences of a Government Laboratory.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Thomas' Café, Swansea).—H. J. Hodsman: Smokeless Fuels and how they burn.

NATIONAL SMOKE ABATEMENT SOCIETY (at College of Technology, Manchester).—A. McCulloch: Coal and its Combustion.

SATURDAY, NOVEMBER 9.

BIOCHEMICAL SOCIETY (in Department of Physiology, University, Liverpool), at 2.30.—Prof. T. P. Hilditch and G. Collin: Regularities in the Glyceride Structure of Vegetable Seed Fats.—H. Rogerson: The Haloid and Oxyhaloid Salts of Bismuth.—Prof. I. M. Heilbron and F. S. Spring: The Colour Reactions and Absorption Spectra of Sterols in Relation to Structure.—R. N. Morton, Prof. I. M. Heilbron, and F. S. Spring: Absorption Spectra in Relation to Vitamin A.—W. Ramsden and R. H. Hurst: The Spacings of Adsorbed Molecules.—L. Earlam: Denaturation of Methæmoglobin by Fat-solvents.—W. Ramsden, J. Brooks, and L. Earlam: De-solutions by Loose Association of Two Solutes.—A. Wormall: The Immunological Specificity of Halogenated and Nitrated Proteins.—A. J. Leigh: Observations on Hagedorn and Jensen's Blood Sugar Method.

MONDAY, NOVEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Papers on Stereographic Survey.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Dr. W. H. Hatfield: Steels for Automobiles and Aeroplanes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. E. Highfield and others: Discussion on Temporary Expedients in Engineering.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings electrically by means of Thermal Storage.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—H. W. T. Taylor: Voltage Control of Large Alternators.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Section) (at Borough Polytechnic), at 7.—Debate on Panel *versus* Direct Heating.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—H. T. Jones and J. S. Willcox: Fertilisers and Feeding Stuffs Act.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—J. D. Pratt: Rationalisation—its Meaning and Application.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. Mortimer: Some Difficulties in Aluminium Alloy Founding, and some Remedies.

TEXTILE INSTITUTE (Yorkshire Section) (jointly with Bradford Textile Society) (at Midland Hotel, Bradford), at 7.30.—Sir Lawrence Weaver: Co-operative Advertising for the Wool Industry.

MEDICAL SOCIETY OF LONDON, at 8.—Dr. J. A. Ryle, Dr. H. Orton, and Prof. E. C. Dodds: Discussion on The Different Methods of Diagnosis in Gastric Disease.

SURVEYORS' INSTITUTION, at 8.—C. H. Bedells: Presidential Address.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Comparative Anatomy Lecture Room), at 8.45.—Prof. E. Hindle: Recent Work on Yellow Fever.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol).

TUESDAY, NOVEMBER 12.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. G. F. Still: The History of Pædiatrics in the XVIIth and XVIIIth Centuries (Fitzpatrick Lecture).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Lieut.-Col. Sir Arnold T. Wilson: Oil Legislation in Central and South America.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. Harbottle: The Opposed Piston Oil Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—E. J. Evans: Feed Heating by Extracted Steam in Generating Stations.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with North-Western Centre of Institution of Mechanical Engineers) (at Engineers' Club, Manchester), at 7.—R. A. Chattock: The Modern Use of Pulverised Fuel in Power Stations.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—G. Morgan: Chairman's Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—J. Wallace: The Super-Sports Motor Cycle.

MANCHESTER COLLEGE OF TECHNOLOGY TEXTILE SOCIETY (at Manchester), at 7.30.—D. Atkinson: The Weaving of Fancy Cloths.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. R. Hay: Age-Hardening in Alloys.
QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. A. Robins: Spiders; Notes on their Life and Habits.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—E. E. Evans-Pritchard: Zande Witch-doctors.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (at Wellcome Historical Medical Museum), at 8.30.—Sir Robert Armstrong-Jones: Superstition.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. E. N. da C. Andrade: Modern Views of Matter (Lecture).

WEDNESDAY, NOVEMBER 13.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—C. Rowntree and others: Discussion on Complications of Operations for Piles.
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—W. E. Prytherch: The Effect of some Impurities in Copper.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. S. Coates: Modern Boiler Practice. Part I.
ROYAL SOCIETY OF ARTS, at 8.—J. O. Boving: New Developments in Hydraulic Pneumatic Engineering.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—V. Henri: The Structure and Activation of the Molecule of Phosgene. An Analysis of the Ultra-Violet Absorption Spectrum of Phosgene Vapour.—Prof. T. M. Lowry and C. B. Allsopp: A Photographic Method of Measuring Refractive Indices.—C. P. Snow and Dr. E. K. Rideal: Infra-Red Investigations of Molecular Structure. III. and IV.—P. M. S. Blackett, P. S. H. Henry, and Dr. E. K. Rideal: A Flow Method for Comparing the Specific Heats of Gases.—*To be read in title only*:—Prof. H. Bateman: The Two Dimensional Motion of a Compressible Fluid.—Sir Almroth Wright: Further Studies on Intertraction.—J. H. Brinkworth: On the Temperature Variation of the Specific Heats of Hydrogen and Nitrogen.—Prof. L. J. Mordell: Kronecker's Fundamental Limit Formula in the Theory of Numbers and Elliptic Functions, and Similar Theorems.—R. W. Lunt and M. A. Govinda Rau: The Variation of the Dielectric Constants of Some Organic Liquids with Frequency in the Range 1 to 10 Kilocycles.—J. A. Hall: The International Temperature Scale between 0° and 100° C.—Dr. E. J. Williams: The Straggling of β-Particles.—W. H. Watson: The Effect of a Transverse Field on the Propagation of Light *in vacuo*.—Prof. J. W. McBain and C. R. Peaker: The Electrical Conductivity caused by Insoluble Monomolecular Films of Fatty Acid on Water.—F. P. Bowden: The Amount of Hydrogen and Oxygen Present on the Surface of a Metallic Electrode.—F. H. Schofield: The Melting Point of Palladium.—Prof. G. P. Thomson: Diffraction of Cathode Rays. III.—K. R. Rao: Regularities in the Arc Spectrum of Arsenic.—H. W. Thompson and C. N. Hinshelwood: The Kinetics of the Oxidation of Ethylene.—Dr. J. A. V. Butler and C. M. Robertson: The Behaviour of Electrolytes in Mixed Solvents. Part I.—F. W. P. Götz and Dr. G. M. B. Dobson: Observations on the Height of Ozone. II.—R. W. James, G. W. Brindley, and R. G. Wood: A Quantitative Study of the Reflexion of X-Rays from Crystals of Aluminium.—U. R. Evans and L. C. Bannister: The Growth of Silver Iodide Films.—Prof. W. E. Curtis and A. Harvey: Structure of the Band Spectrum of Helium. VI.—Prof. J. W. McBain and H. G. Tanner: A Robust Microbalance of High Sensitivity, suitable for Weighing Sorbed Films.—G. I. Finch and D. L. Hodge: Gaseous Combustion in Electric Discharges. IV.—Dr. A. Müller: A Spinning Target X-Ray Generator and its Input Limit.—R. H. Dalton and C. N. Hinshelwood: The Oxidation of Phosphine at Low Pressures.—Prof. O. W. Richardson and K. Das: The Spectrum of H_2: The Bands Analogous to the Ortho-helium Spectrum. II.—F. P. Bowden: The Kinetics of the Electric Deposition of Hydrogen and Oxygen.—J. Hume and L. Colvin: The Decomposition of Potassium Hydrogen Oxalate Hemihydrate.—C. J. Smith: A New Form of Calorimeter suitable for Determining Heats of Solution, with an Application to Worked and Annealed Metals. Dr. C. H. Desch: Appendix.—L. M. Swain: On the Turbulent Wave behind a Body of Revolution.—W. H. Barnes: The Crystal Structure of Ice between 0° C. and −183° C.—Prof. J. C. McLennan, A. B. McLay, and M. P. Crawford: The Spark Spectrum of Thallium, Tl II—Term Analysis—Fine Structure of Lines.—D. M. Murray-Rust and Sir Harold Hartley: The Dissociation of Acids in Methyl and Ethyl Alcohol.—K. S. Krishnan: The Influence of Molecular Form and Anisotropy on the Refractivity and Dielectric Behaviour of Liquids.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. E. T. Whittaker: Parallelism and Teleparallelism in the Newer Theories of Space (Presidential Address).
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Rt. Hon. H. A. L. Fisher: An Oxford Movement (Lloyd Roberts Lecture).
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—R. P. Rowlands: A Review of the Surgery of the Gall-bladder and Bile Ducts (Bradshaw Lecture).
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Lady Cowan: The Child and the Cinema.
INSTITUTE OF METALS (Birmingham Local Section), at 7.—Discussion on Rolling.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with Nottingham Section) (at Victoria Station Hotel, Nottingham), at 7.30.—J. A. Reavell: The Scientific Heating of Liquids and Gases.
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—D. Stewart: Modern Developments in the Petroleum Industry.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—A. Erskine: The Economic Combustion of Coal.
INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 7.30.—H. L. Sulman: Mineral Flotation.
INSTITUTION OF WELDING ENGINEERS (at Caxton Hall), at 7.30.—Dr. W. M. Hampton: The Manufacture and Standardisation of Eye-Protective Glasses.
ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital, Queen Square, W.C.1), at 8.—Clinical Meeting.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch).—Eng.-Capt. J. J. Sargent: Practical Marine Engineering Problems.
BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH RÖNTGEN SOCIETY.

FRIDAY, NOVEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F. Hodgkinson: Journal bearing Practice.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. B. C. Laws: The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.
ROYAL SANITARY INSTITUTE (at Town Hall, Carlisle), at 7.30.—P. Dalton and others: Discussion on Town Planning of Built-Up Areas.—C. J. H. Stock and others: Discussion on Some Dangers and Difficulties of Small Water Supplies.—R. Simpson and others: Discussion on The Veterinarian in Relation to the Milk Supply.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. T. Griffiths: Nickel and its Uses in Engineering.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Special General Meeting.
TEXTILE INSTITUTE (Lancashire Section) (at Rochdale Technical School), at 7.30.—J. Ryan: The Problems of the Cotton Industry with special reference to the Spinners' Difficulties.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Nottingham Section).—J. A. Reavell: The Scientific Heating of Liquids and Gases.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff).—S. Dixon: Some Recent Food Investigations.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. F. A. Mason: Peter Griess.

SATURDAY, NOVEMBER 16.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—C. Fox: Mental Energy.
BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—Conference: Is there a Changing Trend in the Textile Industry?
PHYSIOLOGICAL SOCIETY (at Cardiff).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 8.

LONDON HOSPITAL MEDICAL COLLEGE, at 4.30.—Dr. A. F. Hurst: Precursors of Carcinoma of the Stomach (Schorstein Memorial Lecture.)

SATURDAY, NOVEMBER 9.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—G. T. Clark: Geometry—Boys, Girls, Us.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Wild Flowers in London's Open Spaces.

TUESDAY, NOVEMBER 12.

UNIVERSITY COLLEGE, at 6.30.—E. T. Elbourne: Engineering Management. (Succeeding Lectures on Nov. 19 and 26.)

WEDNESDAY, NOVEMBER 13.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dame A. Louise McIlroy: The Influence of Pathology upon Maternal Welfare.
SCHOOL OF ORIENTAL STUDIES, at 5.15.—H. A. R. Gibb: Ibn Battutah.
ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Sir Arthur Keith: Race Building, Past and Present.
KING'S COLLEGE, at 5.30.—Prof. E. Wilson: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Engineering.

THURSDAY, NOVEMBER 14.

KING'S COLLEGE, at 5.—Dr. W. Robson: Protein Metabolism. (Succeeding Lectures on Nov. 21, 28, and Dec. 5.)—At 5.30.—Dr. J. A. Williamson: The Cabots and the Discovery of the New World. (Succeeding Lectures on Nov. 21 and 28.)

SATURDAY, NOVEMBER 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: The Marvel of India's Canals.

CONFERENCE.

FRIDAY, NOVEMBER 15.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30.—Conference on the Growth of Winter Food for Livestock. In Chair, Lord Clinton.

J. G. Stewart, of the Ministry of Agriculture.
Harald Faber: The Danish Solution of the Problem.
Dr. H. E. Annett: The New Zealand Solution of the Problem.
W. B. Mercer and W. A. C. Carr: Winter Food for Dairy and Feeding Cattle.
Capt. R. Stallard: Winter Food for Dairy Cows.
T. C. Ward: Winter Food for Cattle.

NATURE

SATURDAY, NOVEMBER 16, 1929.

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National Museums and Galleries.[1]

THE Royal Commission on National Museums and Galleries has now presented its general conclusions and recommendations in Part I. of a final report, leaving to a further part specific proposals relating to the several institutions that come under consideration. In the interim report of a year ago, the Commission dealt with certain urgent practical needs and the recommendations were endorsed in their entity by the Government, doubtless stimulated thereto by the public spirit of Sir Joseph Duveen. The Commission has taken additional evidence and examined special problems by sub-committees, of which that on publicity and contact with the public dealt with a subject of vast importance. It has not been concerned solely with the twenty national institutions named in the terms of reference, but has attempted to suggest the directions of policies designed to make all exhibited collections of more value in national life. "The immediate need", as it remarks, "at the present time is for a more active use of the magnificent resources at the disposal of the nation. The potentialities of artistic and scientific education, partially dormant in our museums and galleries, extend to every domain of knowledge, and can be set in motion to influence all classes and sections of the community. But there is to-day inadequate contact, and an absence of dynamic and co-ordinated effort."

A certain individuality and self-controlled growth is a characteristic of most of the great galleries and museums in Great Britain, and each has its devoted, if small, band of adherents who work therein, and never let slip an opportunity to enrich each his own love. There are sixteen governing authorities for twenty institutions, trustees being commonly appointed from such 'lovers', formerly for life, but we trust, as now suggested, for periods not exceeding seven years. There must be competition between some institutions, and it is suggested to seek co-ordination by the formation of a 'Standing Commission' to secure such, to advise on questions relevant to effective development and annually to review draft estimates. This Commission is to have no executive power, but to effect the desired ends "through its central position and prestige". Any such authority to possess prestige higher than that of the Trustees of the British Museum must consist solely of experts in art and science. Its

[1] Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20 September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office, 1929.) 2s. net.

success will depend on its persuasive powers, and clearly its chairman will have to be a full-time officer, while it will require a secretariat which includes specialists in several lines, not least in questions of finance. Each institution in relationship with this Commission is to formulate broad lines of policy, which will avoid overlapping, though, as remarked, often the same objects are treated in science from different points of view. No example of co-operation between the science institutions themselves or with other bodies is given beyond that of the purchase of science books, and the practical results attained on this side are likely to be negligible. Indeed, no Commission will really affect them unless its members have been themselves trained in the scientific ideas that Plato terms 'permanent', founded on the intelligible world with which science deals.

The relations between national institutions and provincial museums and galleries, together with the further development of circulating collections, are subjects of national interest. Local authorities might be induced to provide a room or gallery of reasonable size, and collections of art objects might quite well be transferred monthly from town to town. Many towns have already collections illustrating natural history, and perhaps the best aid here would be the loan from national institutions of experts in display. Loans for exhibition overseas must necessarily be permitted, if the knowledge of British art is to be maintained. This is usually unnecessary in science, but liberty should be secured to allow the loan of any specimen the study of which may enrich knowledge. Experts come to work in every museum, and it is the product of research that, in science at least, is attractive to the public. It is clearly the function of our science museums to encourage such visitors by providing them with reasonable rooms for their often minute and laborious examinations of the collections. Their work reinforces and vastly increases that of the expert staffs, and they form a class of voluntary workers of great importance, always welcomed by their staff colleagues so far as space allows.

In the view of the Royal Commission, immediate efforts should be made to dissipate public apathy. All admission fees should be abolished. The use of museums and galleries in the education provided by public and other secondary schools must be stimulated. Evening lectures should be encouraged. The extension of the hours of opening, so as to include certain evenings up to 10 o'clock, should be tried in all the institutions concerned for two or three years. These changes must be accompanied by drastic rearrangements and simplifications of the contents of galleries so that 'exhibition terror' and fatigue may be avoided. Popular printed guides are necessary everywhere and guide lecturers might become part of permanent organisation. Guide attendants—men of technical training and experience—are employed in the Science Museum, and it should not be beyond the wit of directors to extend their use. Congestion is general; in the science museums, the Commission would clearly prefer part of the present exhibition space to be devoted to students and experts, thereby freeing other areas for selected exhibits.

To make the above effective, the Commission does not hesitate to recommend the most modern advertising methods, including posters. It refers with approval to the work of the Underground Railways in this direction—and perhaps it might also have commended those of the Empire Marketing Board, which certainly excite imagination in the provinces. The only attempt in this direction that we have seen is that of the L.C.C. in respect to the Geffrye Museum in the carriages of the Underground, the advertisement giving particulars of its specialities in exhibition. Contact with the Press is capable of great improvement, so that publicity should not be lost by inadequate handling of information. Guides, photographs, and publications dealing with the collections are to be encouraged, and we would add that they must be supplied to booksellers, who stock any of them, on the same terms as given by any publisher. The staffs of science museums are largely recruited for their knowledge and potentialities in research. As such they may not be the best people to write practical guides, to give popular lectures, to direct publicity and to arrange exhibitions, but we may safely trust the Commission to have considered the employment of specialists on these sides in the final report.

The Commission concludes by indicating what it characterises as "outstanding deficiencies in the National Museum service of the country" which it suggests as eminently suitable for those who desire to be public benefactors. Of these a Museum of Ethnography is long overdue, and a Folk Museum might well form a feature in one of the London parks. The building of new galleries and museums in centres of population will follow any awakening of the public to the immense value of its collections. Meantime, we heartily endorse the Commission's appeal for immediate and dynamic efforts to make our galleries and museums part of the life and heritage of the whole community.

Three Aspects of Light.

(1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 20, Teil 1: *Physiologische Optik.* Von Dr. A. König. Pp. vii + 241. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 23·60 gold marks.

(2) *Lezioni di ottica fisica.* Per Vasco Ronchi. (Pubblicazioni dell' Istituto di Ottica di Firenze, No. 1.) Pp. ii + 494. (Bologna: Nicola Zanichelli, 1928.) 80 lire.

(3) *Le spectre infrarouge.* Par Dr. Jean Lecomte. (Recueil des Conférences-Rapports de documentation sur la Physique, Vol. 14.) Édité par la Société *Journal de Physique.* Pp. 468. (Paris: Les Presses universitaires de France, 1928.) 80 francs.

(1) THE name of the author of this volume of the comprehensive "Handbuch der Experimental Physik" is sufficient guarantee of the excellence of the treatment. Dr. König succeeded Prof. Pulfrich, the author originally appointed, whose work was so unfortunately cut short, when he had framed only a few fragments. These are an introductory chapter on the sense of vision and the other senses, with sections on the motions of the eye, its protective arrangements, the field of vision, and Fechner's law.

The scope of the whole treatise as an introduction to the wide subject of physiological optics is apparent from the fact that the complete range is treated in eighteen chapters which are included in 231 pages. Nevertheless, the entire discussion is very complete; and, being clear, it will serve the more usual purposes of the student better than if detail had been greater.

One chapter deals with the structure of the eye, and another with rod and cone vision. Fundamental phenomena of colour mixture and colour perception are treated in another chapter along with the duplicity theory. Fechner's law and the thresholds of perception are discussed in Chap. v., while Chap. vi. deals with contrast and irradiation. Time relations, accommodation, and after-images occupy the next two; and the following chapter is devoted to the leading theories. Heterochromic photometry and the measure of colour are the subjects of the next two chapters. Then, in a group of three chapters, visual acuteness, judgment of spatial relations, and vision of moving objects are treated. In the following group of three, the subjects discussed involve binocular vision—retinal correspondence, localisation in depth, and the mutual action of the two retinas. In a concluding chapter, the empiristic and nativistic theories of visual perception receive a brief review. Good subject and name indices follow.

The discussion of theory is of special interest in that it includes a brief account of Schrödinger's recent extension of the trichromatic theory on Helmholtz's lines. With only Fechner's law as a guide, Helmholtz succeeded wonderfully in his attempt to obtain an expression for differential sensitivity which would sufficiently comply with observation. It is true that his fundamental stimulations, deduced in this way, are not in accord with Abney's law. But Abney's law had not been found when Helmholtz worked; and Schrödinger himself expressly says that his own procedure, identical in essence with that of Helmholtz with the added inclusion of Abney's law, leads to a result no better than that of Helmholtz in the matter of differential sensitivity. It follows that differential sensitivity cannot furnish a very delicate test regarding the 'absolute' fundamentals in view of the uncertainty of observation. Helmholtz's argument against spectrum red as an absolute fundamental is sound. The addition of Abney's law to the basal data for theory enabled Schrödinger to obtain expressions for saturation and hue in addition to that for brightness. If Helmholtz had made that discrimination, it would have been a guess of most astounding penetration.

The brevity of the account of Schrödinger's work, due to the exigencies of space, is regrettable; for it goes far, and will be extendable whenever experiment supplies the needed data regarding the dependence of the threshold values on the component stimuli.

Hering's theory is detailed, along with the so-called zonal theories. All must be trichromatic in the sense of reducibility to three fundamental variables. The necessary relationship has been given for that of Hering by Helmholtz and Schrödinger; and it is suppliable for all others, including even that of Edridge-Green. This fact, however, does not detract from the value of these theories. For, through *simple* correspondence of their results to various phenomena, they may lead to recognition of the manner of the mechanism of vision.

(2) This is the first of a series of publications projected by the Optical Institute of Florence. In it the treatment of physical optics is developed to an unusually complete extent. There is an introduction of philosophical type, which is generally absent from English text-books, but should be

mentally satisfying to the thoughtful student. Even wave dynamics comes into notice.

In the first chapter the kinematics and dynamics of oscillatory motion are treated in the normal analytical manner; and, in the second, the results are extended to wave propagation, Huygens' principle being applied to reflection and refraction. The clear and logical method of presentation adopted throughout the book is well exemplified in the following chapter on interference. Restrictive postulates are first imposed, and the question of their removal is discussed later. Unidimensional propagation is first taken up, and the results are then extended to suit the cases of two and three dimensions. In the treatment of diffraction, in Chap. v., Cornu's spiral is introduced, and great use is made of it afterwards. The usual cases of diffraction are taken up in detail, and the chapter ends with a discussion of gratings, linear and circular. The results are applied in the following chapter, with great clearness and elaboration, to the discussion of the various forms of apparatus used in interferometry, beginning with Young's and ending with the interferential use of circular and radial gratings. The superposition of effects when two near sources are used with Young's apparatus is considered.

The next three chapters deal with the formation of images: the first with mirrors, prisms, and lenses; the second with vision of luminous bodies; and the third with vision of illuminated bodies. The formulæ for mirrors, prisms, and lenses are deduced; and the problems of achromatism and direct vision are also discussed. The general question of resolving power is dealt with, including that of immersion objectives. The diffraction image of a point source (star) is discussed and figured, and so also are the images of a double point source for the cases in which the central displacement is 1, 2, 3, and 4 times the minimum displacement which gives practical resolution. This leads directly to the determination of the angular separation of the components of a double star, and the angular diameter of a single star, on the principle of Young's interferometer used in conjunction with Michelson's device for increasing the resolving power of a telescope. The analogous use of the biprism, the rectilinear grating, and the circular grating is discussed. The advantages and defects occasioned by the use of the interferometer are carefully stated. In the chapter on vision of illuminated bodies, the question of the formation of shadows and images is treated in similar detail, and is finally applied to the problem of ultra-microscopy.

Chaps. ix. and x. deal with spectroscopy; the former being devoted to the measurement of wave-length, and the latter to the question of the resolving power, the well-known modern methods of attaining high resolution by the use of images of high order being discussed fully.

Chap. xi. is devoted to the discussion of wave aberration, spherical and zonal. The limiting conditions for practical physical perfection are dealt with; and the mode of its attainment in the case of the eye, notwithstanding the coarseness of its solid structure, is described. In the following chapter detail is given to the problem of diffraction and interference when aberration is prominent. Here the illustrations, excellent throughout the book, are specially striking. This is also the case in the next chapter, which deals with the determination of the nature of aberrational peculiarities from observation of their effects. The present deficiency in the development of theory is emphasised.

Two short chapters, on polarisation and photometry, respectively, complete the volume.

The treatment throughout is comprehensive and clear, so that the book is well adapted to the needs of a student who desires a more complete discussion of the subject than that supplied generally in text-books.

(3) This volume deals with the extension of research into about ten octaves of infra-red radiation. The subject is so vast that full treatment is impossible even in a book of nearly five hundred pages. A very full bibliography serves to overcome defects in this direction. Attention is directed to the subject mainly as an extended field for the methods which characterise observation in the visible spectrum, and as a supplier of tests for empirical formulæ or theoretical results—the electromagnetic theory, the theories of black body radiation, of dispersion, of quanta, etc. The practical difficulties overcome in the investigations are those of invisibility, and, still more, of feeble intensity.

Dispersed radiation alone is dealt with, and the author aims chiefly at an experimental treatment, theory being considered when the experimental results bear directly upon it. Some of the subjects are treated briefly in order that, within the limitations of size of the volume, a unified treatment of the whole field, hitherto non-existent, may be supplied. After a brief historical introduction, the various instruments employed are described, and a comparison is furnished. Methods (prism and grating) of separation of radiations follow; and then polarisation and formulæ of dispersion are discussed. Then reflection spectra are detailed

with their dependence on various physical conditions. Later, and even more fully, absorption spectra are treated. Both types of spectra are then discussed with reference to salts of the same, and of different, acids; and theory, classical and quantic, is applied to the discussion of the absorption and reflection bands and their characteristic frequencies, so as to obtain tests of the bases upon which theory rests. Other theoretical relationships and their tests are also detailed.

A chapter is devoted to absorption by gases and vapours in the infra-red spectrum, and its dependence on temperature and pressure. Resonance spectra are also discussed. Discussion of emission spectra, metallic and gaseous, selective and non-selective, with, in the latter case, the verification of the radiation laws (including grey body radiation), occupies another chapter. The volume concludes with a chapter on qualitative and quantitative proofs of the electromagnetic theory, and one on the astrophysical phenomena of planetary, solar, and stellar infra-red radiation.

The book, standing alone as it does in breadth of treatment of its subject, will be a great boon to students and those engaged in research.

W. PEDDIE.

Systematic Zoology and Evolution.

Das Prinzip geographischer Rassenkreise und das Problem der Artbildung. Von Bernhard Rensch. Pp. iii + 206. (Berlin: Gebrüder Borntraeger, 1929.) 14·50 gold marks.

IT has been apparent for a long time that an analysis of the vast assemblage of species and varieties that is the province of systematic zoology would be of first-class importance in evolutionary studies. In performing his task of providing the forms of animal life with names, the systematist was obviously collecting data on which important generalisations might be founded. The description of species and varieties and the recording of the minutiæ of variation, distribution, and nomenclature have always been viewed with some mistrust and disdain by the worker in other branches of zoology. We find even early students like Spallanzani and Gilbert White voicing such disdain. Nevertheless, Darwin, Wallace, Bateson, and others fully realised the value of systematics. They drew liberally on the data and were aware that certain general principles were becoming clearer in the growing mass of systematic descriptions.

During the past hundred years, systematists and faunistic zoologists have made attempts to formulate such general principles. Gloger, M. Wagner, Kleinschmidt, the Sarasins, Gulick, Allen, and Jordan had all, from one point of view or another, made important contributions. It has, however, remained for Dr. Rensch to gather together these earlier essays, to co-ordinate them and in a general survey of specific and racial divergence to present us with a comprehensive principle. Whether we accept Dr. Rensch's results as the only interpretation of the facts, or whether we consider that there are other explanations, is for the moment of secondary importance. We have in his book a working hypothesis and a starting-point.

Dr. Rensch's main thesis may be briefly stated as follows. The most significant systematic unit is the *Rassenkreis*, that is, a complex of geographical races developed directly one from another. The races forming such a *Rassenkreis* replace each other geographically and the adjacent races are fertile *inter se* (though members of a *Rassenkreis* remotely situated one from another may not be so).

Dr. Rensch is careful to point out that the concept of the *Rassenkreis* is not new. In general it is identical with the *Formenkreis* of Kleinschmidt and the 'species' of Hartert and Jordan. Analysis of such groups of animals as are well known systematically shows that the units of and below the rank of species are in a very high percentage members of such *Rassenkreise* and that possibly 70-80 per cent (p. 79) of the described forms occupy this position. He is careful to insist that at present we can only speak with certainty for groups like mammals, birds, and insects. In some groups a high frequency of *Rassenkreise* is to be expected, but it is obscured by individual and 'ecological' variation.

From the purely systematic and nominal point of view we may anticipate that objections might be lodged against Dr. Rensch's categories. He points out (p. 14) that his *Rassenkreise* are not identical with 'species', because, according to the current view, all the individuals of a species are fertile *inter se*, a condition not always found among the members of a *Rassenkreis*. Whether his categories cannot be after all accommodated in our current terminology is arguable. But this question is not the main issue. The significant facts are that homogeneous non-varying groups of the status of species are comparatively rare and the series of linked-up geographical races, the most widely separated members of which assume the morphological status of species, are of general occurrence.

This conception may not strike the zoogeographer as novel, though Dr. Rensch's statistical presentation of the facts introduces a new note. It is the

inferences that may be derived from this apparently universal occurrence of *Rassenkreise* that form the essence of his work. We may present this most simply by quoting two passages verbatim. "Das Studium geographischer Rassenkreise lehrt nun aber dass in zahlreichen Fällen, wahrscheinlich sogar in der Mehrzahl der Fälle, ein ganz allmählich gleitender Übergang von einer Rasse zur benachbarten Rasse zu konstatieren ist" (p. 118). . . . "So lässt also der gleitende Übergang der Rasse auf einer direkte äussere Bewirkung der Rassenbildung schliessen" (p. 126). In other words, there is a general tendency for a graded transition to be found between geographical races, and this tendency is an index of the influence of environmental forces in producing races and ultimately species. On this subject much might, of course, be said. The evidence in support of this thesis (pp. 118-171) is drawn from facts illustrating various distributional 'laws' (Allen's, Bergmann's, Gloger's), the highly significant occurrence of 'parallel variation' and the similarity in cause, distribution, and manifestation between phenotypic and genotypic variation. This part of the work is very ably presented. If the experimental proof that geographical variation is largely of a fixed heredity is somewhat deficient, Dr. Rensch produces enough evidence to make it very likely that an important part thereof may be heritable. 'Mutation' and natural selection seem to be negligible factors in the instances which he discusses.

Dr. Rensch's book is admirably planned. His periodical summaries serve to keep the main issues apparent and his argument is developed by clear and logical steps. It is an impressive statement of the case for modern Lamarckism from the point of view of a student of geographical distribution. Dr. Rensch's statistical treatment of the frequency of *Rassenkreise* would have perhaps been better had he taken one group, for example, birds, and analysed it more fully instead of giving a selection of cases. Evidence as to the selective value of inter-racial and inter-varietal differences might have been sought out more fully, as such evidence does exist and is by no means negligible. It is a little curious to find no account of Harrison and Garrett's work on the origin and inheritance of melanism in Lepidoptera in the various sections in which the origin of this phenomenon is discussed.

Finally, Dr. Rensch does not combat the difficulties raised by accepting the environment as the chief cause of inter-racial and inter-specific divergence. Among these difficulties we may mention the frequent occurrence of related species and varieties in the same habitat, and of species and varieties living unmodified in a diversity of habitats. Dr. Rensch grants the existence of 'individual variation', but surely an estimate of the intensity of correlation of racial divergence with habitudinal divergence is necessary before we assert that environmental difference is the most important factor in racial divergence. G. C. R.

Philosophy of Anthropology.

Anthropology and Modern Life. By Prof. Franz Boas. Pp. 246. (London: George Allen and Unwin, Ltd., 1929.) 10*s*. net.

THOUGH opinions may, and undoubtedly do, differ as to how far it is incumbent upon a science to justify its *raison d'être* by its practical value, it would indeed be remarkable if in the case of anthropology, the science of man, its application to the problems of society were ignored. Yet there are few subjects in which the general public is less informed as to the trend of the results of investigation in relation to the conduct of life, whether for the social group or for mankind as a whole. For this anthropologists themselves may be to blame in some degree; but in a science of so vast a scope, each is concerned with his own special branch of investigation, to the neglect of the more general philosophical problems of the subject as a whole. Those anthropologists who are interested in the practical application of their science have for the most part confined themselves to the question of the administration of the affairs of backward peoples in contact with European civilisation; but few have attempted to direct attention to its bearing upon the problems of the more advanced races.

Prof. Boas is to be congratulated on his attempt to meet a very real need—also upon his courage, for he attacks some cherished conceptions. Thus, for example, he shows a degree of scepticism as to the value of the aims of eugenics which will scarcely commend itself to the more ardent advocates of the proposals for racial betterment associated with that subject. In this, as in other branches of anthropological investigation, Prof. Boas shows a common sense and clarity of judgment which refuse to accept the idols of the market-place at current valuation. He is cautious in regard to generalisation and tenacious as to facts. Hence he holds equally that the arguments of the eugenist are neutralised by the variability in family heredity, and that generalisations as to racial character, both

physical and mental, are usually vitiated by concentration on a selected type within the group.

The author's criticism on this latter aspect of anthropological argument applies perhaps to the writings of publicists and popular authors who have used ready-made conclusions without a knowledge of the facts, rather than the anthropologists themselves. The latter, at any rate for the most part, are more than cautious at the present day in the care with which they refrain from attributing homogeneity to any specific national or geographical group.

As regards the author's own views on his subject, much might be said, though perhaps he is inclined to be more critical than constructive. His examination of the trend of social development from the simpler forms of social unit is at least logical in its forecast of the ultimate predominance of the larger group, which will inevitably tend, in his view, to internationalism.

Industrial Waste and its Treatment.

The Recovery and Use of Industrial and other Wastes. By John B. C. Kershaw. Pp. xvii + 212. (London: Ernest Benn, Ltd., 1928.) 25*s.* net.

TO the pessimist, the waste material of his factory is something of no value which must be got rid of as cheaply as possible. Unless prevented by government restrictions, he is content to discharge it into the sky or into neighbouring streams, or to dump it upon the surrounding land. To the optimist, all waste material is potentially valuable, if only the right method can be obtained for converting it profitably into something useful.

To a large extent the facts have so far justified the optimist. Many waste-treatment plants, which were originally installed to prevent a nuisance, have turned out to be profitable undertakings. The recovery of hydrochloric acid from the waste gases of alkali works, as the result of the Alkali Act of 1863, led to the foundation of a new branch of industry. During the present century, metalliferous dust has been recovered profitably in large quantities from the fumes discharged by copper smelters in America and elsewhere. The recovery of sulphur from alkali waste by the Chance process, the utilisation of blast-furnace slag, and the recovery of tin from tin-plate scrap, are typical of the methods which have been developed for converting useless waste material into a profitable source of income.

Mr. Kershaw is clearly an optimist, to whom every waste-heap is a potential Tom Tiddler's ground. His book is a challenge to the chemist and the chemical engineer to make all this hidden wealth available.

The book is a collection of articles which have appeared in various technical journals, and gives a fairly complete survey of the various channels through which power, heat, and materials are wasted in a number of different industries. In some cases the methods adopted successfully for the prevention of waste, or for the profitable utilisation of waste materials, are clearly described. After four chapters devoted to waste in the chemical industry, in engineering shops, metallurgical works, and mines, a very interesting account is given of the methods which are employed by different municipalities for the collection and utilisation of the contents of dust bins and garbage pails. Other chapters deal with the waste from paper mills, sugar factories, tanneries, slaughter-houses, fish-curing yards, rubber factories, and sawmills.

The book should interest those who are concerned with the management of industrial undertakings, and should also prove stimulating to the young scientific worker seeking fresh fields to conquer.

W. E. G.

Our Bookshelf.

Recent Advances in Neurology. By W. Russell Brain and E. B. Strauss. (The Recent Advances Series.) Pp. xii + 412. (London: J. and A. Churchill, 1929.) 12*s.* 6*d.*

THE authors' purpose is to persuade fundamental principles to emerge from a wealth of detail concerning the important neurological contributions of recent years, and they "can confidently assert that the book contains matter of direct concern to the student of medicine, physiology, therapeutics, pathology and (indirectly) psychology". Chief among the authors' intentions is that all the subjects treated should have a clinical bearing; "in other words, that the book should be an auxiliary text-book of *applied* neurology". It may, of course, be that advances in applied neurology bear more eloquent testimony to the state of the parent science than could any book; but it is doubtful whether "the qualified student of medicine reading for higher examinations" and the seeker after fundamental principles can be satisfied at one and the same time.

The misleading title apart, the authors have done exceedingly well, and candidates for membership of the Royal College of Physicians are certain, until the subject matter of the book becomes too widely disseminated among them, to derive very practical benefit from its use. An eminently practical discussion of cistern puncture, lumbar puncture, sub-dural and epidural injection of

lipiodol and radiography follows appropriately on the cerebro-spinal fluid and hydrocephalus. The next fifty pages deal with intracranial tumour and some related topics. Four and a half pages deal with the problem of the control of the cerebral circulation adequately if the conflicting and contradictory nature of the evidence at present available is taken into account. It is difficult to know how such a subject as posture and tonus should be handled in a book dealing with 'advances': the fourteen-page survey here given is fair. It is to be hoped that the student reader will prefer to think that something still eludes investigators rather than to be cynical concerning the display of disagreement. Three chapters are devoted to the disorders of movement, one to the pituitary and the hypothalamus. Pavlov's work, "The Conditioned Reflex", is abstracted at some length because "the demonstration that 'functional' nervous disease has a physiological basis . . . is a great practical advance". Brief as it is, the chapter on sleep, normal and pathological, is a welcome addition to the accessible literature. A longer chapter on sensation fairly reviews the essential features of Head's work and opinions. Thereafter the work is chiefly of medical interest.

The Spectroscopy of the Extreme Ultra-Violet. By Prof. Theodore Lyman. (Monographs on Physics.) Second edition. Pp. vii + 160. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 10*s.* 6*d.* net.

IN 1914, when the first edition of this book appeared, the ultra-violet frontier of spectroscopic territory was at about 900 A. Nothing was known of the region lying between this and the X-rays; it was even uncertain whether there was anything to know, although it seemed probable that the gap in question was attributable to experimental difficulties rather than to an actual absence of radiation. Further, the exploration of the extreme ultra-violet had been carried on almost entirely by two men, Schumann and Lyman. The gap has long since disappeared, the vacuum spectrograph has become a commercial product, and numerous workers are engaged in the survey of these spectral regions. Prof. Lyman therefore had no easy task in preparing the second edition which is the subject of this notice. Technique has advanced to such a degree, and our knowledge is so much more extensive, that much of the book had to be entirely rewritten. In addition to the new data presented, some account is given of the more important recent developments, as, for example, the discovery of the part played by ozone in atmospheric absorption, the use of gratings at grazing incidence, and the exploration of the 'Millikan region'.

The wave-length tables have been completely revised, and now include data for H_2, He, He^+, C, N, O, Al, and CO. The book is throughout purely experimental in outlook, which possibly explains, although it does not excuse, the omission to replace out-of-date series designations such as $OS - mP$ and $OS - 1\pi$ by their modern equivalents. Apart from this, the only noticeable slip in the book is a remark about the "Blaethswood machine at the National Research Laboratories in England", but most English readers will have no difficulty in interpreting this correctly. Numerous references to original papers are given in the text, but it is doubtful whether any very useful purpose is served by repeating them all in a bibliographical appendix. This, however, is scarcely matter for complaint or criticism, and need not diminish our gratitude to Prof. Lyman for this exceedingly valuable contribution to spectroscopic literature.

The A B C of Psychology. By C. K. Ogden. Pp. x + 279. (London: Kegan Paul and Co., Ltd., 1929.) 4*s.* 6*d.* net.

WRITTEN to afford a brief account of "the nucleus of accredited opinion" from which the growing science of psychology is tending to develop, this short work is everything it should be; intelligible, easy almost to the point of flippancy (but not quite), impartial, detailed, crowded with information to a degree which must be measured to be believed, critical and yet individual, succeeding as a personal contribution unmistakably but without bias or excess. Half a dozen pages suffice for the presentation of matters pertaining to the core of psychology from the author's point of view, yet the book, which is dominated by them, maintains its balanced character.

A better name than 'double language hypothesis' may soon be coined as a label for the view of the mind-body relationship defined in a few pages of Chapter ii. Language is essentially 'linguistic' (Ogden) or 'grammatical' (Head), and the suspicion is growing that so far from its "saying it another way", the linguistic or logical method does not say anything at all concerning what we do when we think. The author says every statement is translatable. Behind the neurological point of view is scepticism of language as an appropriate system of symbolic representation of either itself or similar neuro-psychological events. The phrase thus invites hostility. Is it true that the psychologist can translate his language into symbols free from the bondage of words? If he can, a bi-representational solution of the mind-body problem may be possible. Why does Mr. Ogden on p. 1 cast aside ontology as useless to psychology?

Patent Law and Practice. By A. W. Griffiths. Pp. xxvii + 174. (London: Stevens and Sons, Ltd., 1928.) 7*s.* 6*d.* net.

AT a time when several of the standard works on patents are out-of-print, there should be a good demand for this clear, concise, and inexpensive account of the present state of the law. The author, it is true, bases his discussion on the highly debatable theory that "a manner of manufacture is essentially an operation", but the principles which he enunciates are far less dependent on the validity or otherwise of this theory than might seem to be implied by such a statement. (By the way, it is to be regretted that lawyers still persist

in using the phrase "*manner of* manufacture" when they mean simply "manufacture"—an error due to a misunderstanding of the archaic English used in the Statute of Monopolies.)

Compactness has been obtained by the use of a very direct style, in which words are economised, and by the omission of such padding as the Acts and Rules, which can be purchased for a small sum from H.M. Stationery Office. The selection of leading cases is judicious, and is presented in a form which enables their relevance to be readily understood. The book contains, in addition, a number of sensible suggestions, put forward with becoming modesty, as to the right determination of various unsettled points of law. It can be recommended with confidence not only to students, but also to manufacturers and others who may be interested in the movement for the reform of the patent system which was inaugurated by the British Science Guild's recent report on this subject.

Mechanical Aptitude: its Existence, Nature, and Measurement. By John W. Cox. (Thesis approved for the Degree of Doctor of Science in the University of London.) Pp. xiii + 209. (London: Methuen and Co., Ltd., 1928.) 7*s.* 6*d.* net.

THE object of this research was to inquire into the existence and psychological nature of what has been variously called 'mechanical ability', 'mechanical ingenuity' or 'mechanical sense'. A clear understanding of this would certainly be of great value in vocational guidance and selection and in certain branches of educational practice. The general lines of the research, method of treatment, and argument follow those already laid down by Prof. Spearman in his studies of intelligence. A number of tests demanding ability to handle and interpret mechanical models, diagrams, etc., was given to different groups and the results subjected to detailed statistical treatment. The author draws the conclusions that there does seem to be evidence in favour of the reality of a special mechanical ability not dependent on general intelligence alone and that this can be measured. If this work should be substantiated, the consequences will be very valuable, for it will be possible to select those children with the ability and give them every opportunity for its development, while those lacking it can be diverted from occupations where success depends upon it. The research is a very valuable piece of pioneer work and its conclusions may be pertinent to psychological theory.

Einleitung in die physiologische Zoologie (*Physikalische und chemische Funktionen des Tierkörpers*). Von Prof. Dr. Hans Przibram. Pp. vi + 182. (Leipzig und Wien: Franz Deuticke, 1928.) 10 gold marks.

THE increasing tendency of zoology to turn from the more purely morphological towards the functional aspects of the subject, and to utilise the data of chemistry and physics in their study, has induced Prof. Przibram to write an introduction to physiological zoology which can act as a companion to his introduction to experimental morphology, and enable the student to gain a comprehensive outline of the subject before turning to one of the larger treatises. The work is divided into some thirty short chapters arranged in pairs, and dealing respectively with the physical and chemical properties of the different organs of the body: numerous references are given throughout the text: notes on the chemical composition, including formulæ, of substances referred to in the text are collected together in an appendix. In a small space the author has succeeded in covering a very large field and in giving an excellent outline of the subject of general physiology. The work could be read with profit by all students of physiology or zoology, but in the short time at their disposal will probably be found to range the field too widely to appeal to those studying within the narrower limits of human physiology. However, for all those who wish to know something of how animals of different species live, of their varying types of respiratory apparatus, of their modes of digesting and assimilating their food, of their secretions and excretions, their sense organs, or their reproduction, this short treatise can be thoroughly recommended for perusal.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 9: *As, Sb, Bi, V, Cb, Ta.* Pp. xiv + 967. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 63*s.* net.

THE ninth volume of Mellor's "Comprehensive Treatise" covers the tervalent and quinquevalent elements, arsenic, antimony, bismuth, vanadium, columbium, and tantalum. These elements do not possess the exceptional interest of the earlier homologues, nitrogen and phosphorus, which were described in a separate volume, but they are very fertile in producing chemical compounds of the type of vanadium heptabromo antimonite, VBr_4, $SbBr_3$, $7H_2O$, which are vouched for by chemical analysis but have not yet been provided with satisfactory structural formulæ. In these circumstances the volume is likely to pass more quickly than would otherwise be the case to the bookshelf which contains the earlier members of the series, there to await trial by usage as a work of reference.

Even so, there are sections which can be read with interest and pleasure, since arsenious oxide has a lurid history as a poison, and the sulphide has played a large part in the development of our knowledge of the laws which govern the behaviour of colloidal suspensions: the allotropy of the elements also presents an interesting problem, as the term 'explosive antimony' reminds us, and finally, these metalloids have given rise to some of the best examples of compound formation in alloys. These details are, however, unimportant compared with the main fact that the author has completed another section of this task, and thereby increased proportionately the obligation of his fellow chemists to him.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electron Collisions with Molecules and Resultant Quantum Losses.

FOR several years I have been conducting experiments on inelastic collisions of electrons with molecules, observing the quantum losses so sustained. The method has been described in the *Proceedings of the Leeds Philosophical Society*, January 1926, p. 65 (Brett and Whiddington), and in the *Philosophical Magazine*, November 1928, p. 899 (Jones and Whiddington). It consists in producing electrons of known speed by accelerating from a hot filament to a grid or slit, thereafter passing them through the gas and then analysing by a magnetic spectrum method. This is a specially powerful method, in that on one photograph is recorded the energies possessed by the electrons over a very wide range.

The kind of spectrum obtained is indicated in Fig. 1,

FIG. 1.

which is only a moderately good example of its kind. In the middle of the strip is the sharp edged 'full velocity' line (corresponding to $eV = \frac{1}{2}mv^2$, where V is the potential applied between filament and grid); on the right and fairly close to the full velocity line are clear indications of lines or heads of lower velocity and corresponding to the losses above mentioned. Still further on the right is a much lower velocity band or wide line, to which I now wish to direct particular attention.

This band is always present in photographs of this kind and it has been a puzzle to explain. Its position is variable, its intensity considerable, usually very much more intense than the full velocity line which it accompanies; occasionally the full velocity line is even absent entirely, or at any rate present very faintly.

Quite recently, a modified form of the apparatus has been in use, the chief change being the introduction of an 'electron gun' of the type employed in the Western Electric oscillograph. Much the same kind of electron spectrum was obtained. This led to a very simple experiment in which the gun was mounted in a glass flask and made to produce (in argon) the luminous beam, which was then deflected by a uniform magnetic field. It was immediately noticed, however, that keeping V fixed and the field constant, the radius of curvature of the beam diminished very rapidly with reduction of pressure.

Fig. 2 shows this effect very clearly. In this photograph the pressure for the least curved beam is about 0·001 mm. and for the most curved beam is about 0·0003 mm., the potential and field being constant.

Calculation of the electron volt velocity of these extreme beams varies, of course, from experiment to experiment, but in a particular case was found to vary from 40 volts to 150 volts, the applied voltage being 260 volts.

It is clear, therefore, that in an 'electron gun' used in this manner the velocity of the beam may often be much less than that calculated from the simple formula.

One possible explanation I believe may be found in considerations based on the discharge which is probably occurring within the gun. If the electrons forming the luminous beam be supposed to come not from the filament but from the edge of the dark space or its

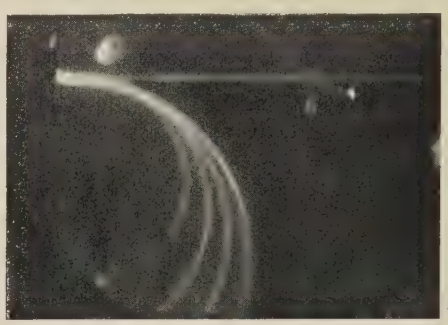


FIG. 2.

equivalent within the gun, then everything is qualitatively explained. With reduction of pressure, for example, the dark space widens, the source of supply moves nearer to the anode, and the effective eV consequently falls in value.

There are other interesting matters in this connexion which for reasons of brevity must be omitted now, but the examination is being continued further.

R. WHIDDINGTON.

The University, Leeds,
Oct. 23.

The Quantum Theory of the Absorption of Light.

IT is well known that some years ago Smekal introduced the notion of 'double quantum switches' which are responsible for both coherent and incoherent scattering of light. These double switches consist in a transition from a given state of the atom k to some 'intermediate' state n, and back either to k or else to some other state l, the result being the emission of a light quantum $h(\nu - \nu_{lk})$ instead of the absorbed $h\nu$. This theory has since been justified by the new mechanics. Now it seems to me that its implications have not been fully realised, and it is my purpose to apply them to the problem of absorption of light by the conversion of light energy into heat.

The main point is that the intermediate states n of the double switch $(k \longrightarrow n \longrightarrow l)$ have a definite *duration*, although a much shorter one than that of the two end states. This is contrary to the usual assumption, which does not regard the state n as 'really' occurring, and it involves a temporary breach of the conservation of energy, though this is an objection that can be easily overcome formally. The mechanism of the switch requires the use of *two* probability coefficients B'_{kn} and the much greater B''_{nk}, which are a generalisation of Einstein's well-known B.

Turning now to our main object, the explanation of absorption, this is produced when the atoms in the state n undergo collisions of the 'second kind', so as to turn their internal energy into heat. The method of perturbations of the quantum theory yields N_n, the number of atoms in state n, as

$$N_n = N_k \frac{E_0^2 |p_{nk}^0|^2}{h^2} \frac{\nu_{nk}^2 + \nu^2}{(\nu_{nk}^2 - \nu^2)^2}, \quad . \quad . \quad (1)$$

where E_0 is the incident electric force and p_{nk}^0 the appropriate matrix element of electric moment. If

ν' represents the probability per second of a collision of the second kind, then heat is developed at a rate

$$Q_n = \nu' N_n \cdot h\nu = N_k \frac{E_0^2 |p_{nk}|^2}{h} \frac{(\nu_{nk}^2 + \nu^2)\nu\nu'}{(\nu_{nk}^2 - \nu^2)^2}. \quad . \quad (2)$$

This may be compared with the classical expression given by the 'collision damping' theory of H. A. Lorentz. Taking the case of a single elastically bound electron, if $\pi\nu''$ denotes the number of collisions per second, that theory gives as the heat produced

$$Q = \frac{N}{2} \frac{e^2}{4\pi^2 m} E_0^2 \frac{2\pi\nu''\nu^2}{(\nu_0^2 - \nu^2)^2 + \nu^2\nu''^2}, \quad . \quad (3)$$

or, replacing the quantity e by its quantum equivalent and omitting the small term in the denominator,

$$Q = N \frac{E_0^2 |p_{nk}|^2}{h} \frac{2\nu^2\nu_{nk}(\pi\nu'')}{(\nu_{nk}^2 - \nu^2)^2}, \quad . \quad . \quad (4)$$

which only differs slightly from (2). The reason for the difference is not clear to me, but it scarcely seems to discredit the theory that absorption of light is effected by atoms in intermediate states undergoing collisions of the second kind, with a temporary violation of the law of energy.

It would perhaps be possible to test the theory experimentally by observing the presence of atoms or molecules having large kinetic energy of order $h\nu$. The presence of such atoms in relatively small numbers is characteristic of the quantum theory, whereas in the classical theory of Lorentz the absorption is the result of a small amount of internal energy transformed into heat at each collision of every molecule.

J. FRENKEL.

Physico-Technical Röntgen Institute,
Leningrad, Oct. 13.

Adaptations and the Influence of Light on Animal Tissues.

PROF. MEEK, in his letter to NATURE of Oct. 5 on 'Adaptation', has used in illustration of his views instances of crustacean races (of the amphipod *Gammarus duebeni* and the copepod *Canthocamptus pygmæus*) residing in pits and mines which had lost their colour and eyes without losing the power of reproducing those features on becoming once more acquainted with light. In Prof. Meek's opinion, more prolonged exposure to environmental strain might make this restoration more difficult by impairing the reversibility of the reaction, and he suggests that this sort of adaptation to life in the dark is 'psychogenetic' in origin. In addition to the many eyeless Crustacea of purely cavernous habit, *Cyclops agilis* Koch has been found underground with degenerate eyes, but the same and four other species of *Cyclops* as well as *Canthocamptus staphylinus* Jurine have often been found in the dark with normal eyes; loss of pigment has been observed in certain Ostracoda in similar situations (Moniez, *Bull. biol. N. France*, **1**, p. 176; 1888).

Prof. Meek's observations become additionally interesting in the light of the famous experiment by Kammerer when eyes were regenerated by the blind newt *Proteus* on exposure to red light, or pigmentation restored in full light (NATURE, May 1923, p. 237), and it may be useful to place on record here certain notes made by myself this summer.

The amphipod genus *Niphargus* of 'well-shrimps', blind and colourless, makes a not infrequent appearance in quite recently dug wells, which is still an unsolved problem in spite of certain species found in caverns or deep in lakes. Among twenty forms two have been described with degenerate (lemon-yellow) eyes, one with small eyes, two with pale body colour (Stebbing, 1906—"Amphipoda Gammaridea"—in "Das Tierreich", Lief. 21). The Île d'Arz in the Morbihan, south Brittany, is entirely devoid of natural water; the inhabitants have dug numerous shallow wells to a little below sea-level in which the depth of water is affected by the tide as if the main supply were filtered from the sea, though it is perfectly sweet. Cattle are rationed with water by pailfuls poured into shallow stone troughs beside the wells, in the largest of which (not dry with August sun like the others) I found a fine male *Niphargus* swimming on its back quite undisturbed by the strong sunlight, much resembling a 'fairy-shrimp' in its motions. The specimen was one inch in length, of a yellowish-brown colour, with well-marked red-brown eyes which have faded in alcohol; there are curious deeply melanic areas at the apices of the peduncles of the second antennæ and at the tip of the right first antenna, also at the injured point of left first antenna which is broken near the base. The specimen does not agree with any of the 'good' species, but many prove to be the partly described *N. rhipidiophorus* (Catta, 1878), also with small eyes and found in a brackish well at the mouth of the Rhône.

Another well contained many small *Asellus aquaticus* L., fully pigmented and with eyes; A. *aquaticus* v. *freiburgensis* Schneider, found in mine-water, was colourless with well-developed eyes, and blind species have been found in caves or deep in lakes (Moniez, loc. cit., p. 254).

The Triclad Turbellaria include many blind and colourless subterranean forms, one of which—*Polycladodes cavatica* (Fries)—may develop pale colours and regenerate eyes in springs which emerge to the surface. Colourless (v. *corsica* Arndt and v. *bathycola* Steinmann) and eyeless (v. *anophthalma* Mrazèk) races of *Planaria alpina* (Dana) have been discovered; indeed, in its normal situations a varying small proportion of individuals are grey or white instead of black, while the young worms are quite colourless when hatched, so that failure of the pigment should be relatively easy; moreover, the frequent reproduction by eyeless tail-buds might favour the formation of blind stocks in the dark. In the Leith Hill district of Surrey I found a colony of *P. alpina* breeding (sexually) in a stony bed fourteen inches below meadow land, the exit of the stream being by filtration through the overlying soil. The worm avoids mud on account of its toxicity for the species, and, since it is also found at the mouth of nearly every underground field-drain in the neighbourhood, the impression obtained was that this colony must be the relic of one originally living in its typical home at the head of one of the local stony or rheocrene springs, some of which have become overlaid with alluvium in the course of time. Yet, although the individuals of this subterranean colony must have been long deprived of light, they were deep black and perfect in eye. Moniez (loc. cit., p. 143) has recorded the finding of normally pigmented *Polycelis nigra* (Ehrenberg), *Planaria polychroa* Schmidt, and eyed specimens of *Dendrocœlum lacteum* (Müller) in underground situations.

On the other hand, keeping *Planaria lugubris* Schmidt (a river species very near to *polychroa*, which normally obtains much light) in the dark, I have repeatedly observed marked reduction of the dark brown extra-enteric colour without any deterioration of eye. In another species—*Planaria vitta* Dugès—which is colourless, I have examined (by courtesy of Dr. H. A. Baylis of the British Museum) a local race from subterranean water in Devonshire, the eyes of which are perceptibly smaller than in races from open streams in south Devonshire or at Aberystwyth.

It would seem that the loss of pigment and eyes in subterranean species is by no means immediate, and is effected much more slowly than their restoration with the light. This is perhaps less surprising on reflection that the swift physiological response to light in higher animals includes a persistent effect—the 'after image'—which is longer in duration than the latent period of response to the stimulus; application and deprivation of light are here not of equal value when considered as environmental strains potent to disturb the constituents, and if they are not equally able to alter a temporary balance it may be they are also not equally able to alter the permanent architecture of animal cells. We should also recall that the effects of radiations, when affecting protoplasm, obey the rule required of any physiological stimulus that there be sufficient intensity applied for a specific minimum of time. This holds good in the physiology of vision and is well seen in the production of heritable effects by X-rays, as well as in therapeutic experience, both with radiations and radium; it may therefore be equally applicable in the case of such genetic modifications as may conceivably be produced by the prolonged effect of light (or its deprivation) on gonadial cells.

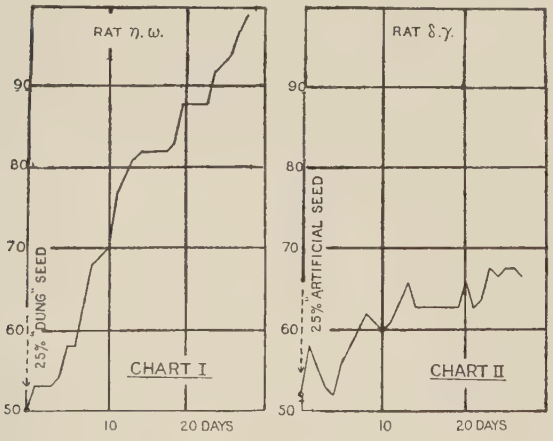
MICHAEL PERKINS.

5 Little Cloisters,
Westminster Abbey, S.W.1, Oct. 22.

Vitamin Contents of Grass Seeds from Treated Plots.

I HAD noted on my farm for many years the animals, especially pigs, that had been fed on home ground and home grown wheat and barley thrived better than those fed on purchased barley meal and 'cake'.

Following upon this, I pegged out in one of my fields two areas: one area was dressed with dung from animals to which foods containing a high content of vitamin B had been given; the other area of grass in



the same field received artificial manure. The spreading of the dung on the grass was at the rate of twenty loads to the acre, and the spreading of the artificial manure was at the following rate: basic slag 10 cwt. to the acre, kainit 3 cwt. to the acre, and sulphate of ammonia 1 cwt. to the acre.

In July of this year the grass was cut by hand and the seeds from the grasses of each area were kept absolutely separate. The seeds from these grasses were threshed out by hand and were fed to rats with the view of demonstrating the vitamin content of those grass seeds which had been grown on the dunged area and that grown on artificial manure.

Chart No. 1 demonstrates the growth curve of rats fed on dunged grass seeds, and chart No. 2 demonstrates the growth curve of rats fed on the artificial manured grass seeds. I attribute the increased growth, as shown in Chart No. 1, on the dunged grass seeds, as due entirely to the vitamin B present in the excreta of the animals which had been fed on a high vitamin B content diet. This raises an extremely important point that vitamin B is present in the embryo of grass seeds and is entirely dependent, or certainly to a large extent, on the food consumed by the animal the excreta of which is used for the manufacturing of dung.

Further details will be published at a later date.

M. I. ROWLANDS.

1 Knightsbridge Court,
12 Sloane Street, S.W.1,
Oct. 12.

Handling Molten Lead.

SEVERAL letters were published in issues of NATURE during September and October 1928 (vol. 122, pp. 349, 507, 610) under the title "Can the Hand be thrust in Molten Lead without Injury?" In reply to the inquiry, two correspondents testified from personal experience to the safety of the demonstration. As few people seem to have done the experiment even in these days, it may be of interest to publish the following description of it which has just come under my notice in a volume published so long ago as 1594 entitled "The Jewell House of Art and Nature". By Hugh Platte. (Printed by Peter Short, dwelling on Breadstreet Hill, at the signe of the Star and are to be solde in Paules Churchyard.)

"How a man may safely put his finger and hand into molten lead, without danger of burning."

"Take of quicksilver one once, Bole Armoniack of the best two ounces, Camphire half an onnce, common Aqua vitae two ounces, first beate, and then mingle all these well togither with a pestle in a brazen morter, then annoint your hands al ouer thrughly well with this ointment, and be sure that your hands are cleane without itch or scabbe. I did see a Dutchman called Haunce, a prety nimble Chimist, who after he had set some lead on the fire in a melting pot, till it became blewish and exceedingly hot, hee stirred the same first with his forefinger vp and downe, pretending to see whether it were not too hot to endure in the palme of his hande, and afterwards telling his fellow that it was of a good temper, he caused him to poure the same out being some half a pound in weight into the palme of his hande, first prepared as before, and presently he poured it into his other hand, and so out of one hand into another fiue or sixe times together, till in the ende he threw the same cold upon the ground. This hee did for a pot of the best Beere in a garden in Southwarke about ten or twelve yeeres sithence, in the presence of myself and diuers others."

E. H. GREGORY.

Rothamsted Experimental Station,
Harpenden, Herts.

Regeneration of Spines in *Echinus esculentus*.

REGENERATION of the spines in *Echinus esculentus* is considered worthy of record, and is of importance with regard to the short fine spined forms which are sometimes obtained in the trawl or dredge. It seems probable that such natural, fine spined individuals, which are sufficiently strange to be regarded, not unreasonably, as a different species, may have been

damaged in some way, as by rubbing and exposure during a previous capture, and have afterwards recovered as in the case of the specimen observed. The observation is also of interest in indicating that the species possesses unsuspected powers of regeneration, and may be a favourable subject for experiments on regeneration under suitable conditions.

The accompanying photograph represents, on the left, a specimen of *Echinus esculentus* which lived for some weeks in one of the tanks of the Marine Biological Station at Port Erin and, after apparent death, produced a second crop of spines. The original spines first lost their erect condition and lay, as is usual in moribund specimens, scattered irregularly over the

FIG. 1.

surface at the test. The specimen lost its hold upon the side of the tank, on which it had migrated to the surface of the water. Owing to decomposition of the capsular muscles the spines became detached and fell to the bottom of the tank. The specimen was, apparently, dead. My attention being directed to other matters, the specimen was not at once removed, and my surprise was great when, some days later, a new crop of minute spines had made their appearance all over the surface of the test. These were allowed to remain until some growth had taken place, then, being anxious that the specimen should not be lost, I preserved it in spirit.

The dimensions of the specimen and of the new spines are as follows :

Diameter of test at ambitus . . .	9·5 mm.
Height ,, ...	7·5 mm.
Length of major spines around peristome .	8 mm.
,, ,, ,, at ambitus . .	4 mm.

The photograph on the right represents a normal specimen from the same locality as the above.

H. C. CHADWICK.

Marine Biological Station,
Port Erin.

Sexual Behaviour in Birds.

WHAT Dr. Marshall is so good as to say in NATURE of Oct. 26 in regard to my advocacy of the principle of inter-sexual selection makes it, I think, incumbent upon me to point out that I did not originate the idea of this, any more than of sexual selection in the ordinary sense. Darwin had considered the possibilities here also, but unfavourably, which I attribute myself to the want of sufficient evidence at that time. He indeed makes prominent mention of certain cases in which the usual order of courtship, as between the sexes, is reversed, but does not say anything (unless I am mistaken) in regard to mutuality in this respect, or of another factor which seems to me to have a profound bearing on the question. I allude to functional hermaphroditism in birds which, in so far as alternate preparation is concerned, I recorded in the *Zoologist* (May 1902) in the case of the great-crested grebe, and, later, in *Wild Life* (July and August 1915) in that of the little grebe, where such preparation was carried into action under conditions not admitting of doubt. Thus the common ideas as to the profound psychological and temperamental differences between the 'ardent' male bird and the 'coy' female would seem to be based on error, to the consequent weakening of any argument so arrived at. The erotic foundations being similar on either side, the superstructure raised on them might very well also be, and this, I think, as tending to dispose of an initial difficulty, makes the class of fact above mentioned my principal contribution to evidence in a case which had been opened and still remained *sub judice* at a time when I had nothing about it in my notes.

Now, however, I have much there which I believe to be quite *as* important, at any rate, from an evolutionary point of view as well as, in many cases, going, if not beyond that root principle, at least farther back in it and pointing to other things as well – observations, in short, which it is, I think, in a high degree the duty of any field observer to place upon record (*in extenso*) *if he can*. Should there be any channel through which he can, without being put to the expense of personal production, he would, in this instance, be very glad to know of it, since otherwise, owing to the little interest taken by any but a very small section of the general public in original field observation, some half-dozen volumes *in posse*, of that description, seem less likely to be awaiting publication than the posthumous waste-paper basket.

EDMUND SELOUS.

Wyke Regis Castle,
near Weymouth, Dorset.

The Homogeneous Oxidation of Acetylene.

FOR many years the slow oxidation of hydrocarbons has been thought to be a reaction taking place at a surface. We have succeeded in demonstrating the wholly homogeneous character of a hydrocarbon oxidation and have obtained conclusive proof of the chain nature of the reaction. Just as this work was completed, Mr. C. N. Hinshelwood, of Oxford, informed us privately that he had obtained similar evidence for hydrocarbon oxidation, which is to be published shortly.[1]

The oxidation of acetylene by oxygen proceeds at 250°-315° through the stages of glyoxal, formaldehyde, formic acid, carbon dioxide, and water. Schematically, the reactions are :

$$\left.\begin{matrix}\mathrm{CHO}\\ |\\ \mathrm{CHO}\end{matrix}\right\} \longrightarrow \mathrm{CO} + \mathrm{HCHO} \xrightarrow{+O_2} \mathrm{HCOOH} \xrightarrow{+O_2} \mathrm{CO_2} + \mathrm{H_2O}$$

$$\left.\begin{matrix}\mathrm{CHO}\\ |\\ \mathrm{CHO}\end{matrix}\right\} \longrightarrow 2\mathrm{CO} + \mathrm{H_2} \longrightarrow \mathrm{CO} + \mathrm{H_2O}.$$

All these reaction products have been isolated.

Kinetically, the behaviour of the reaction is abnormal in that the rate of reaction is proportional to the square of the acetylene concentration and is almost independent of oxygen.

In packed vessels the rate of the homogeneous reaction is reduced manyfold. Instead, a heterogeneous oxidation direct to carbon dioxide and water takes place, the rate of which is proportional to the product of the acetylene and oxygen concentrations.

A paper describing these results in full will appear shortly in the *Journal of the American Chemical Society*.

G. B. KISTIAKOWSKY.
S. LENHER.

Experimental Station,
E. I. du Pont de Nemours and Company,
Wilmington, Delaware.

[1] The paper is "The Kinetics of the Oxidation of Ethylene", by Thompson and Hinshelwood, and was published in the *Proc. Roy. Soc.* for September.—EDITOR.

Raman Effect and Electrolytic Dissociation.

A STUDY of the Raman effect in nitric acid at various concentrations has revealed two interesting features which have a bearing on the phenomenon of electrolytic dissociation. In concentrated nitric acid (about 65 per cent acid), nine Raman lines have been found, three of which correspond to water. Of the others, three lines showing wave number differences of 958, 1312, and 3319 cm.$^{-1}$ seem to belong to the HNO_3 molecule. The other three, which are also found in nitrates, with wave-number differences of 630, 689, and 1050 cm.$^{-1}$ belong to the NO_3^- ion. Photographs taken indicate that the Raman lines belonging to the HNO_3 molecule gradually disappear with increasing dilution. On the other hand, the lines belonging to the NO_3^- ion increase in brightness up to a certain dilution and then diminish with still further dilution. The dilution corresponding to the maximum brightness of the NO_3^- lines is not far from that at which the HNO_3 lines just disappear. This is clear evidence of the dissociation of the HNO_3 molecule.

Water, which gives three diffuse bands at 3208, 3419, and 3582 cm.$^{-1}$ wave number differences, shows a peculiar behaviour. Not only do the three bands become sharper with increasing concentration of the acid, but the band corresponding to 3208 cm.$^{-1}$ gradually diminishes in intensity until it becomes very faint in the concentrated acid. The band 3582 cm.$^{-1}$, which is the weakest of the three in pure water, gains rapidly in intensity and becomes in the concentrated acid the strongest of the three bands.

It is expected that intensity measurements, which are in progress, will throw light on the current theories of electrolytic dissociation.

I. RAMAKRISHNA RAO.

Wheatstone Laboratory,
King's College,
London, Oct. 9.

Molecular Spectra and Molecular Structure.

THOSE who contributed to the recent Faraday Discussion on molecular spectra and molecular structure have now sent their written versions to the secretary for publication. Instead of the report we gave of Prof. Barker's explanation of the double Q branch of ammonia at 10·3 μ and 10·7 μ (NATURE, Oct. 12, p. 587), we should like to substitute Prof. Barker's own written version :

" The ammonia molecule probably has the form of a triangular pyramid of small altitude. Two of the four fundamental modes of vibration involve an oscillation of the N atom along the axis of symmetry, *i.e.* normal to the plane of the three H atoms. The band at 10·5 μ is associated with a symmetrical motion of the H atoms such that the distance between them increases when the N atom approaches the plane in which they lie. The equilibrium position of the N atom may be upon either side of this plane ; hence the potential energy function exhibits two minima separated by a relatively low maximum. Two *eigenfunctions* must therefore be associated with each vibration state, one being symmetrical and the other anti-symmetrical. Because the two equilibrium positions are not far apart these two functions involve slightly different amounts of energy, and the vibration levels are all double. Finally, since transitions are always between states of opposite symmetry character, *e.g.* $1_a \longrightarrow 2_s$ or $1_s \longrightarrow 2_a$, two absorption bands appear with slightly different frequencies."

W. E. GARNER.
J. E. LENNARD-JONES.

The University, Bristol.

New Cellulose Methylene Ether.

SYMMETRICAL dichlorodimethyl sulphate isolated by Fuchs and Katscher (*Ber.*, **60**, 2288 ; 1927) has been found to react with soda cellulose (using Haworth's technique) giving monomethylene cellulose of maximum OCH_2 content 17·2 per cent and corresponding with the formula $C_6H_7O_2(OH)(O_2CH_2)$.

Other methylene inorganic and organic esters give somewhat similar results. This reaction is evidently exactly analogous to that between soda cellulose and dimethyl sulphate, except that only two of the three hydroxyl groups of the $C_6H_{10}O_5$ unit take part in it.

Hitherto, all work on the reaction between cellulose or starch and formaldehyde has given either the so-called ' absorption compounds ', or with acid catalysts only partially methyleneated products. Two recent papers on this subject deal with these aspects of the reactions (Blanksma, *Rec. Trav. Chim.*, 361 ; 1929, and Meunier and Guyot, *Comptes rendus*, 188, 506 ; 1929). It is hoped to be able to establish the structure of monomethylene cellulose now described for the first time, and particularly to apply the reaction to many of the sugars and starches.

Monochlorodimethyl sulphate reacts with soda cellulose giving a mixed methyl methylene cellulose ether of limited interest only.

FREDERICK C. WOOD.

21 Egerton Road, Fallowfield,
Manchester, Oct. 18.

Influence of Particle Size on Diamagnetism.

IN a recent note to NATURE (July 13, p. 53), Sir C. V. Raman referred to some experiments made with me which showed that the diamagnetic susceptibility of graphite falls off steadily with increasingly fine subdivision of the substance. A single crystal of graphite gave a specific susceptibility ($\times -10^6$) equal to 18·1 parallel to the hexagonal axis, and 2·7 perpendicular to it, the average over all directions being 7·8. With powdered graphite this number diminishes to 5·1, while for finely divided colloidal graphite it falls so low as 2·2.

Further experiments by me have disclosed a similar effect with metallic antimony, though not of such a striking character. Massive antimony has a specific susceptibility ($\times -10^6$) equal to 0·78, which diminishes to 0·71 with colloidal antimony when the average particle size is 6 μ and further drops to 0·54 with particles 150 $\mu\mu$ in size. It is known that the diamagnetic susceptibility of antimony falls off with rise of temperature, or on fusion, and that it is considerably less for antimony in chemical combination than for the free metal. It appears that mechanical subdivision or ' colloidalisation ' influences the diamagnetism in the same way.

V. I. VAIDYANATHAN.

Annamalai University,
Chidambaram, South India, Oct. 1.

Periodic Precipitations and Diffusion.

IN a recent communication (*Proc. Roy. Irish Acad.*, 38 B, p. 445) we classed Prof. Wolfgang Ostwald's theory of periodic precipitations amongst those in which precipitation should occur at or near the " head of the diffusion column ". In reality, as Prof. Ostwald has kindly pointed out to us in a private communication, according to his theory the " critical mixture ratio ", which determines the formation of a precipitate, should always lag behind the head of the diffusion column. This objection to Ostwald's theory is therefore not valid.

HUGH RYAN.
R. J. DOYLE.

University College, Dublin.

The Shannon Hydro-Electric Power Development Scheme.

By Dr. BRYSSON CUNNINGHAM.

ALTHOUGH not quite equal in capacity to the leading modern hydro-electric installations of the North American continent, some of which have been noticed in previous issues of NATURE,[1] the Shannon undertaking, which is now at the point of effective operation for partial development, is a notable enterprise for a country of the size and resources of the Irish Free State. Indeed, it may justifiably be described as a national adventure, ambitious in scope and fraught with momentous economic consequences. On one hand, its promoters and advocates expect it to rehabilitate the industrial activities of the country; on the other hand, doubts have been, and continue to be, freely expressed as to the possibilities of its financial success. The boldness of its conception in unpropitious circumstances and the importance of the rôle which it is designed to play in the resuscitation of Irish industry, entitle it to attention as a remarkable engineering achievement of modern times.

Actually under consideration and execution for the past six years or so, the inception of the scheme really dates back to the year 1918, when the British Government became anxious about the shortage of coal supplies, and, searching for other sources of power, appointed in June of that year a committee to report on the water power resources of the United Kingdom. In the following November a sub-committee for Ireland was nominated with the same terms of reference. As the reports and findings of these committees have already been published and commented upon in NATURE, there is no occasion to say more here than that the Irish Sub-Committee selected four rivers (the Shannon, the Erne, the Bann, and the Liffey) for investigation, and made them the main theme of their Report of Dec. 6, 1920, together with a number of important recommendations on water power development generally.

The matter was further considered by a Commission of Inquiry into the Resources and Industries of Ireland which reported in 1922. The next step appears to have been taken on the initiative of the German firm of Siemens-Schuckwerke, which in February 1924 placed before the Irish Free State Government certain proposals for developing the hydro-electric capacity of the Shannon. In September of the same year the Free State Government referred these proposals to four continental experts (Messrs. Waldemar Borgquist, of Stockholm, Eugen Meyer-Peter and Arthur E. Rohn, of Zurich, and Thomas Norberg Schulz, of Christiania (Oslo)) for consideration. The report of these engineers was favourable, subject to some suggested modification of the plans in detail. The Irish Government thereupon adopted the scheme and initiated legislation in order to give it effect. Passed by Dail Eireann in April 1925 and by the Oireachtas in the following June, the Shannon Electricity Act duly became law, and the execution of the necessary constructional works was forthwith entrusted to the German company.

The Shannon is the longest river in Ireland, and, indeed, in the British Isles. Its total length from

FIG. 1.—The basin of the river Shannon.

[1] NATURE, Aug. 27 and Sept. 3, 1927, and July 27, 1929.

source to mouth is 240 miles; its main stream, exclusive of the tidal estuary below Limerick, is about 160 miles. The catchment area above Killaloe is some 4500 square miles, nearly one-sixth of the area of the Free State. The upper course of the main stream for a length of 125 miles lies mainly on the great central plateau of Carboniferous limestone, running through three great lakes (Lough Allen, Lough Ree, and Lough Derg) which have an aggregate surface area of 65,000 acres. For this part of its course the river is a sluggish stream with a fall of not more than 55 feet, which is less than 6 inches per mile. The lower course from Killaloe to Limerick, a distance of 15 miles, is very different in character. The fall is more than 90 feet, or 6 feet per mile, and it is this section of the river which is being exploited for the production of power.

It has been a fortunate circumstance that river flow data were to hand covering an extensive period. The available discharge ranges from 900 cusecs to 32,000 cusecs, the former being minimum dry weather flow, and the latter, discharge during flood in the winter season. With a rainfall of 946 mm., the average discharge in the lower part of the river is 8500 cusecs.

The Shannon project in its entirety envisages three successive stages of development for the whole river, involving in the later stages impounding works at the lakes in order to increase their storage capacity. As a complete account would take more space than is available at the moment, attention will be confined in this article to the first stage or "Partial Development", which is the extent of the present undertaking. This consists of works below Killaloe and comprises a weir across the river bed to maintain the water level and divert the required amount of flow into the head race, an artificial channel about $7\frac{1}{2}$ miles in length, which conducts the stream at constant level to the power station at Ardnacrusha, with its penstocks and turbines; and finally the tail race, $1\frac{1}{4}$ miles long, which conveys the discharged water back into the bed of the Shannon at a level of about 100 feet below the point of intake.

The weir is situated at Parteen Villa, $5\frac{1}{2}$ miles below Lough Derg, on a site consisting of an outcrop of hard red Devonian sandstone covered with shingle. Lake conditions will be continuous right up to the weir, so that it is anticipated that very little silt will be formed. Before deciding upon the design, which had to make provision for full discharge of the river in case the power station should be closed down, a series of experiments was carried out with various models at the hydraulic laboratory of the Technical High School, Berlin, under the supervision of Prof. Dr. Ing. Ludin. The experiments, in which the effects and characteristics of the flow of the river, taken at its maximum of 920 cub.m. per sec. (32,000 cusecs), were carefully studied, resulted in the selection of an arrangement of six openings, the two central apertures being each 10 m. wide, and two pairs of side openings, each 18 m. wide. The central openings are provided with low sills 10·9 m. below upstream water level, and the other four at first with high sills, or crests, at 2·70 m. below the same datum. Afterwards, the two 18 m. wide openings on the left bank of the river were replaced by two 10 m. wide openings with low sills

FIG. 2.—View of intake building at Parteen Villa after filling of head race had begun.

similar to the two central openings, thus making four deep sluices and two shallow sluices. A fish-pass is also provided.

The intake works at the entrance to the head race comprise three sluice gates each 25 m. wide and 5·7 m. deep, operated by mechanism from a bridge gangway, and a ship's pass 10 m. wide and 5·9 m. deep. This last is required for navigation purposes, since the old Shannon Navigation Canal will no longer be available. Under the new conditions, boats from Limerick will traverse the Abbey River, then the Shannon for a short length, then the tail race as far as the power house, where a couple of locks rising 100 feet and capable of taking 150 ton craft, will give them access to the head race, whence they can pass into the upper river channel.

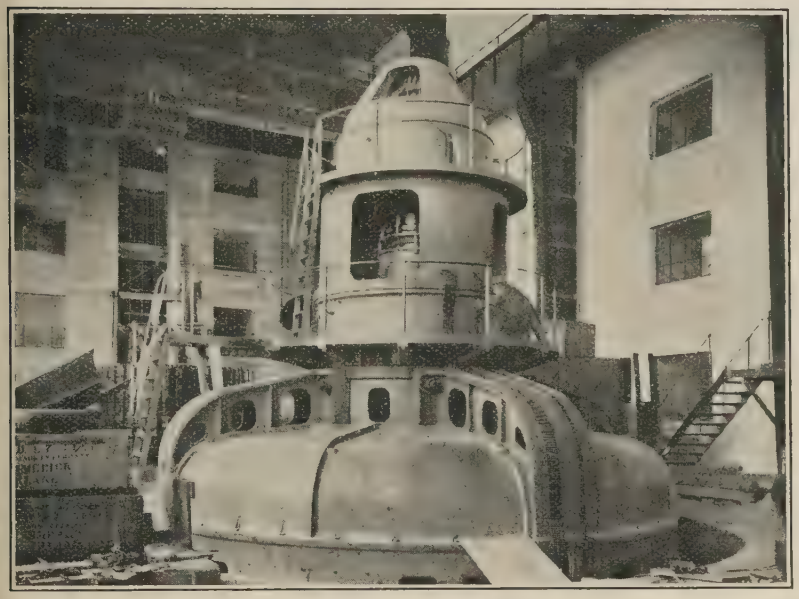


FIG. 3.—Generator I. completely erected.

The power house is at Ardnacrusha, a few miles above Limerick. It is a reinforced concrete building with six openings in the base or dam to admit the flow. For the present, only three are being utilised, and these lead to three penstocks or steel pipe conduits, each 6 m. in diameter and 40 m. long, set at an angle of 59° to the vertical. At the foot they are deflected to the horizontal and taper gradually to a diameter of 4·8 m. as they enter the special casings of the turbines. These are of the Francis type, set vertically and designed to develop from thirty to forty thousand horse-power each, according to the available head, which varies with the tidal level in the estuary, from 86 feet to 115 feet. At normal inner water and mean tide levels the head is 94 feet. The turbines are geared directly to 30,000 k.v.a., 10,500 v. generators running at 150 revolutions per minute with a power factor of 0·7. The three turbines will thus develop some 90,000 horse-power, which is considered sufficient for the demands of the Irish Free State for the present and the immediate future. At a later date, three more turbines can be installed, and the output doubled.

The intention is to supply electricity over the whole countryside by means of a network of transmission lines running north, south, east, and west. The electrical energy generated at 10,500 volts in the power station at Ardnacrusha is there 'stepped up' to voltages of 110,000 and 38,000. At these respective potentials, it is transmitted over three main sets of high tension transmission lines. The 110,000 volt lines form the primary distribution. A six conductor line runs from Ardnacrusha to Dublin, a distance of 116 miles, and a three conductor line to Cork, 59 miles. The 38,000 volt lines are designed to effect loop transmissions, and the 10,000 volt lines are to be used for local distribution, conveying the current to 10,000/380/220 volt transformer stations in towns and villages.

Current was supplied over the transmission lines for the first time in an operating sense on the evening of Oct. 21 last to practically all centres of population in the Irish Free State south of a line drawn between Galway and Dublin. The area north of Dublin will be connected up by the time this article is in print, and, finally, the capital itself within a few weeks will be included in the service controlled by the Electricity Supply Board.

It is this widespread national service which constitutes the serious economic aspect of the question. The scheme contemplates the creation of a universally electrified Free State. But Ireland, at any rate at present, is almost wholly an agricultural country; its manufactures, except in some few detached areas, are of negligible account. Is it possible to create a demand throughout the country which will reimburse the national exchequer

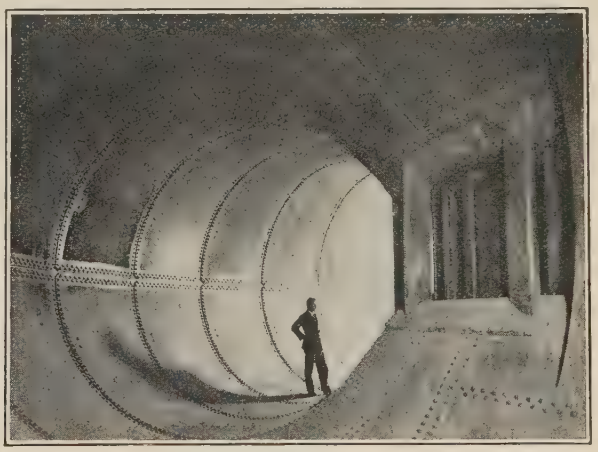


FIG. 4.—Spiral casing of a 36,000 h.p. turbine.

for the eight millions or so of expenditure on the scheme, or, at any rate, meet the capital charges on the outlay, together with expenses of operation? For the moment, the supply is greatly in excess of the demand, which depends almost entirely on consumption for civic and domestic purposes. Even in regard to domestic application, the proposition is not very attractive to the potential consumer, who, as an Irishman, is notoriously conservative in his habits and unlikely to be won over to new methods unless they are accompanied by palpable saving in expense. The idea at first entertained of supplying current to the Dublin switchboards at a cost of about $\frac{1}{2}d.$ per unit has long since been abandoned, and critics of the scheme now hint at the imposition of rates which may well be considered prohibitive except to the well-to-do householder. Dublin, indeed, will be the chief customer; at present it takes something like four-fifths of the electric current produced in the Free State, largely for its tramways. But the Dublin tramways are already suffering from the competition of motor omnibuses, and the fate of tramway undertakings in Great Britain is not reassuring for a lengthy continuance of this channel of consumption. Practically, the question resolves itself into the problem of the creation or resuscitation of Irish industries requiring large supplies of power and the establishment of manufactories throughout the country; and on this issue few will dare to speak confidently.

Considered as an engineering enterprise, the scheme is a definite success, in that it has undoubtedly been carried to the point of effective realisation, and great credit attaches to those whose duty it has been to work out the manifold technical details associated with an undertaking of this magnitude. Not least among the difficulties have been the problems of transporting and handling heavy pieces of plant and huge quantities of material in localities not altogether favourable for such purposes. The total equipment for the electrical and mechanical part of the installation weighed 34,000 tons, and about 6000 tons of this had to be shipped from Germany, unloaded at Limerick or the vicinity, and transported to the power station and weir with rather inadequate facilities for handling. Excavation operations at the power station involved the removal of a quarter of a million cubic yards of earth and 200,000 cubic yards of blue limestone rock. The concrete dam at the base of the building contains 80,000 cubic yards of concrete. Constructional operations were in the hands of the Siemens-Bauunion, associated with the Siemens-Schuckwerke A.-G., the main contractors for the entire undertaking, to whom we are indebted for the photographs accompanying this article.

The Shannon installation is a convincing manifestation of the confidence of the Free State Government in the future commercial development of the country, and all well-wishers of the Emerald Isle will hope that its anticipations may be realised.

Graptolite Centenary, 1829–1929.

By Dr. HENRY M. AMI, Laboratory of Geology and Palæontology, Ottawa, Canada.

IT was in 1829 that Adolphe Brongniart first described 'graptolites', two of them, and both from the black carbonaceous shales of the Point Levis cliffs opposite the city of Quebec, Canada. Brongniart was a botanist, and although graptolites are marine animals of the hydroid type, these two forms went the rounds of the different museums of natural history in the Jardin des Plantes, Paris, and at last were described in the *Prodrome* for 1829 as plants. Plants they do certainly appear to resemble, giving leaf-like expansions, venations, moss-like characters, etc., all of which led early palæontologists to ascribe generic and specific names to the graptolites they described —*Phyllograptus angustifolius*, *Dipl. folium*, *Tetragr. bryonoides*, etc.

Graptolites are all extinct forms of life; they abounded all over, and in the waters of the Palæozoic ocean, when that continent 'Laurentia' first exposed its gneissic and granitic mass above the level of the waters, and graptolite remains, by tens of millions, in certain strata of palæozoic age comprising part of the earth's crust which was subjected to intense folding and accompanying distortion and dislocation. The very presence of graptolites in those rock-formations has helped so materially to unravel some of the knottiest problems in stratigraphy and chronological geology which presented themselves to the human mind in many countries, that some notice of the rôle which they played might be considered timely. Thus, graptolites settled the age of the Bendigo goldfields of Australia; they settled the succession of the highly folded Shropshire and other rocks in western England, Wales, etc.; the 'Highland controversy'; the 'Quebec Group' of Logan in Canada; the 'Taconic controversy' of the New England states; and of similar problems in Scandinavia, Bohemia, France, and in the two Americas, north and south, all along that belt of Andean and Cordilleran mountain chains in which palæozoic strata, also carrying graptolites, occur from Patagonia (Argentina and Chile) to Alaska and the Yukon.

Canada is *par excellence* a paradise for graptolites; and graptolites in a remarkably fine state of preservation have attracted British and other palæontologists, whilst Hall's graptolites from Quebec are famous the world over. Canadian species are recognised in Australia, Europe, Africa, and the Americas. Sir Wm. Logan, T. Sterry Hunt, Elkanah Billings, Sir Wm. Dawson, Spencer, and others in Canada; Emmons, Vanuxém, Hall, Walcott, Weller, Ruedemann, and others in the United States, all attacked the difficult problems of the Lower Palæozoic, and graptolites had their say. The 'knights of the hammer' in Great Britain and Wales: Hicks, Ramsay, Aveline,

Jukes, Sir Archibald Geikie, Peach, Horne, Lapworth, Marr, and Watts, had many swords to cross before the true decipherings of the lower and upper zones of graptolites in the highly contorted strata were effected and orderly sequence recognised.

Of all the men, however, who threw light upon graptolites and their value as horizon-markers, there came one—Charles Lapworth—as if sent in the nick of time, who, with his assistants in Mason College and the University of Birmingham, Prof. W. W. Watts, Miss E. M. R. Wood (now Dame Shakespeare), and Miss Gertrude Elles, established a school for studies in graptolites, completely revolutionising the situation the world over. Lapworth's discovery of the 'sicula', the remains of the old free-swimming zoïd, and the part it plays in the economy of the group was a revelation. The modes of budding, the precise angles and directions taken, was a key which opened the door to rational interpretation of this remarkably useful type of life in deciphering difficulties in tectonics. Suffice it to say that Lapworth has left behind him many monuments, but his contributions to science in his systematic and satisfactory classification of the graptolites and their contemporaries, the *Rhabdophora*, his monographs in the Palæontographical Society's memoirs, together with whole volumes of as yet unpublished manuscripts on the graptolites and graptolite zones of Canada, mark him out as a great 'light', a true naturalist in the highest sense of the word. In her "Evolution of the Graptolites", also, Miss Elles, of Newnham College, Cambridge, on whose shoulders Lapworth's mantle naturally fell, has co-ordinated the development of graptolites in time with the zones of their occurrence in the earth's crust. In critical regions of great geological complexity, the very presence of a graptolite was and is the signal for great rejoicing among structural geologists.

The greatly folded strata of Scotland, western England and Wales, of the St. Lawrence Valley in Canada, or of the Hudson River Valley in the United States, or those of the Scandinavian palæozoics (where Linnarsson, Brögger, Törnquist, Tullberg, Holm, Wiman, and others have wrought), or of other parts of the earth which held many 'nuts to crack', have been the witnesses of intensely interesting discussions in which graptolites played a most conspicuous part, humble yet important types of life, the centenary of which is marked by the present year 1929.

News and Views.

His Majesty the King has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal medals: A Royal medal to Prof. J. E. Littlewood, for his work on mathematical analysis and the theory of prime numbers. A Royal medal to Prof. R. Muir, for his contributions to the science of immunology. The following awards have also been made by the president and council: The Copley medal to Prof. Max Planck, of the University of Berlin, for his contributions to theoretical physics, and especially as the originator of the quantum theory. The Davy medal to Prof. G. N. Lewis, of the University of California, for his contributions to classical thermodynamics and the theory of valency. The Hughes medal to Prof. Hans Geiger, of the University of Kiel, for his invention and development of methods of counting alpha and beta particles.

The following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on Nov. 30:—*President:* Sir Ernest Rutherford; *Treasurer:* Sir Henry Lyons; *Secretaries:* Dr. H. H. Dale and Dr. F. E. Smith; *Foreign Secretary:* Lord Rayleigh; *Other members of council:* Dr. E. J. Allen, Dr. C. Bolton, Prof. A. E. Boycott, Prof. C. G. Darwin, Dr. C. G. Douglas, Sir Alfred Ewing, Prof. E. W. Hobson, Sir Frederick Hopkins, Dr. W. H. Mills, Prof. E. A. Milne, Sir Peter Chalmers Mitchell, Prof. T. C. Philip, Dr. A. B. Rendle, Mr. A. A. C. Swinton, Prof. W. W. Watts, Prof. C. T. R. Wilson.

Disquieting news concerning the conditions of scientific workers in Russia have again reached Great Britain in the shape of newspaper reports to the effect that Prof. S. F. Oldenburg, the well-known orientalist and the second oldest member of the Leningrad Academy of Sciences, who has been its permanent secretary for twenty-five years, has been dismissed by the Soviet Government. The reason for this extraordinary action is purely political; for Prof. Oldenburg is officially charged with concealing from the Government, on the premises of the Academy, some important documents, in particular, the original act of abdication by the Tsar, and accounts of several pre-revolutionary political organisations, thus wilfully depriving the Government of material that could be helpful in tracing counter-revolutionary plots. It is stated that a police-raid has been carried out on the premises of the Academy on the information supplied by one of the new 'red' academicians, elected by order of the Government some months ago. Several of the old academicians then protested against this order, but Prof. Oldenburg, always one of the most loyal supporters of the present Government, insisted on carrying it out to the letter. The effect of admitting politicians into a scientific institution on a party basis has soon become apparent.

In the House of Commons on Nov. 6, Lieut.-Col. Fremantle had down the question, "To ask the Prime Minister if it is the intention of His Majesty's Government, in appointing the Royal Commission on the Civil Services, to review the status and functions of the large body of scientific and technical experts engaged in the Civil Services, with a view to the furtherance of scientific knowledge, methods, and research of those services; and if, seeing that there is no representative of science nor anyone engaged in the application of science to the needs of the community, he will consider the addition to the Royal Commission

of a due proportion of such representatives". The answer given by the Chancellor of the Exchequer was: "The Royal Commission has been appointed to inquire into and report on the structure and organisation of the Civil Service, conditions of employment of Civil Servants, and conditions of retirement from the Civil Service. Its terms of reference have been widely drawn, and it will be for the Commission itself to determine the extent to which the various subjects within the scope of the reference can profitably be reviewed. I am satisfied that the Commission as now constituted is well adapted to the purposes of the inquiry and I am not prepared to enlarge its numbers."

As often occurs in Parliamentary replies, the main point of Col. Fremantle's question is evaded. The first sentence merely summarises the terms of reference, and the second asserts that the Commission is capable of determining their scope. When, however, it is stated that the Commission "is well adapted to the purposes of the inquiry", we dissent most strongly. In the selection of its members no consideration seems to have been given to the necessity of including anyone who understands what science and research mean in the State service. Such subjects as relative rates of pay for men and women, position of ex-Service men, and so on, will no doubt be well represented in evidence and carefully judged by the Commission, because no special knowledge is required to comprehend them. We have far less confidence, however, in the ability of the Commission to appreciate the significance of the scientific and technical sides of the Civil Service and to place them in such correct adjustment with the administrative branches as is demanded by modern conditions.

By cultivating the tubercle bacillus through a long series of generations on a bile medium, Calmette, in association with Guérin, has succeeded in rendering the organism non-virulent though still possessing protective and immunising powers. A preparation containing this modified tubercle bacillus under the name B.C.G. (that is, 'Bile-Calmette-Guérin') is now being tested on the large scale as a preventive vaccine against tuberculosis both in man and in animals. According to reports which have appeared in the daily Press, Prof. Cantacuzène, of Bucharest, has carried out tests with this preparation in Rumania during the past three years, involving the inoculation of 17,535 persons, which incontrovertibly show the value of the preparation. Out of more than 1000 children living in surroundings favourable to the development of tuberculosis who had been vaccinated, not a single case had been recorded, and no ill effect had followed vaccination or re-vaccination with B.C.G.

In Australia, Prof. Woodruff and Mr. Gregory have carried out experimental work with the B.C.G. vaccine as a preventive of tuberculosis in cattle (*Jour. of the Council for Scientific and Industrial Research*, vol. 2, 1929, p. 137. Melbourne: H. J. Green). A number of calves were inoculated with amounts of B.C.G. up to 100 mgm. None of the animals showed any ill effects, the only lesion produced being a small nodule which in course of time generally disappeared. Twenty vaccinated calves were afterwards tested by intravenous inoculation of virulent tubercle bacilli to determine their resistance towards virulent infection. Six of these animals died as a result of extensive tuberculosis in about the same time as unvaccinated control animals. The remaining fourteen showed some clinical symptoms but later became normal, and on slaughter, although some lesions of tuberculosis were found, in the majority these did not appear to be progressing. It is concluded that B.C.G. vaccination confers some degree of resistance towards infection with virulent tubercle bacilli.

There has recently been issued, as a White Paper, the Report of the Departmental Committee on the Royal Veterinary College appointed last year by the Minister of Agriculture and Fisheries (London: H.M. Stationery Office, 1*s.* 3*d.* net). The Committee, which sat under the chairmanship of Sir C. J. Martin, was asked to consider and report generally on the reconstruction of the Royal Veterinary College and the probable cost, and to advise what arrangements should be made in respect of the Animal Pathology Research Institute now situated at the College. After referring to the deplorable condition to which the College has been reduced both as regards buildings and finance, the Committee states that this "has not been due to any lack of enthusiasm on the part of those few members of the Governing Body who for many years past have been sufficiently public-spirited to devote attention to the affairs of the College, or to the small staff who, despite their meagre salaries and wholly inadequate facilities, continued loyally at their work. It is nothing less than extraordinary that the College has been able, in spite of the most depressing circumstances, to turn out year by year a regular flow of qualified students." A possible way out of the difficulties was offered after the War when the Ministry made a definite suggestion to the Governors for the transference of the College to Cambridge, but the Committee reports that "For reasons which, on consideration, we are bound to say appear to us to have been adequate, the Governors could not see their way to accept the suggestion", and later, "We are of the opinion that a transfer to another city would be inimical to its best interests". The Report contains considerable detail of the course of training necessary for the scientific attainment desirable for a veterinary surgeon and the status of the veterinary profession, and passes on to deal with the accommodation and equipment needed to meet the increasing demand for adequately trained veterinarians, not only as veterinary practitioners but also by the State and public authorities at home and in the colonies.

The principal conclusions of the Committee may be briefly summarised as follows. The condition of the Royal Veterinary College is a national disgrace; it needs rebuilding and re-equipping. For reasons detailed, a rural site is undesirable. The College should be situated in the vicinity of a centre of population and should be closely associated with a university. It would be in the best interests of the College to remain in London and to secure recognition as a

School of the University of London. A building as planned could be erected on the site at Camden Town where it has been since its foundation in 1791. The estimated approximate cost of the suggested new buildings, including equipment and freeholds, may be put at £300,000. The cost of staffing and maintaining the new College would involve an additional charge on the College funds which may be roughly estimated at £21,000 per annum. It would be unwise to embark on the erection of new buildings unless such additional income were in sight. The Research Institute should remain where it is, but should be provided with a Field Station in the vicinity of London for the purpose of experimental work with the larger animals, and a sum of £25,000 should be made available for its purchase and equipment. The government of the College should be reconstituted under a revised charter. Exclusive responsibility should be in the hands of a small body of men, selected for their personal qualities and acquaintance with the needs of veterinary education.

ON Nov. 8, an important meeting was held at the Caxton Hall, Westminster, to further the fund for the establishment of a school of archæology in Iraq. It will be remembered that this was a cause which the late Miss Gertrude Bell had much at heart, as was shown by the letters, previously unpublished, written by her, which appeared in the *Times* that morning. The chair was taken by Major-General Sir Percy Cox, who read a letter of support from the Prime Minister, who was unable to be present. Among the speakers were the Archbishop of Canterbury, Mr. L. S. Amery, Lady Astor, Sir Frederic Kenyon, and Sir Francis Humphreys, the newly appointed High Commissioner, who, assuring the meeting of his sympathy, undertook to make another attempt to induce the British Treasury to contribute. Of all the tributes to the work of Miss Bell, that of Mr. Amery was most striking, informed as it evidently was by a knowledge of all she had done in Iraq, both as an archæologist and as a government officer during and after the War. Significant, too, was his expressed hope that recognition of the effect of achievement in the sphere of culture as affecting a nation's international standing might lead to the establishment of a ministry for these matters. The Hon. Secretary of the Fund, Sir Edgar Bonham-Carter, stated that the fund now stands at £6000 and that the Trustees of the British Museum have agreed to devote to the School the income from the £6000 left by Miss Bell in her will. It is hoped to raise a sum of £44,000.

SOME points of general interest to archæologists were put forward by Sir Rennell Rodd when presiding over the annual meeting of the subscribers of the British School of Archæology in Athens, which was held in London on Nov. 5. Pointing out that our knowledge of the ancient world is growing rapidly, and that, moreover, there is so much to be done that it is beyond the resources of a single nation, he suggested that some projects of archæological research might be made a matter of international effort. He considers that this might be a function of the Committee for Intellectual Co-operation of the League of Nations. He went on to indicate as a further activity the identification and classification, according to priority of interest, of sites for ultimate exploration and protection. While opinion may differ as to the suitability of this Committee as at present constituted to undertake the work, there can be no two opinions that international organisation and co-ordination are greatly to be desired. Those who know something of the inner workings of archæological exploration since the War are well aware that it has been hampered and also that effort has been wasted through lack of such international co-operation. We hope the matter may not be allowed to rest here.

WE have received from a correspondent, W. W. L., a letter in which, referring to notices of works on witchcraft which have appeared recently in NATURE (see especially Oct. 5, p. 521, and Nov. 2, p. 678), the question is raised as to the attitude of modern writers on this subject. It is suggested that they assume tacitly that European religion and modes of thought are superior to 'pagan', thus taking up the attitude of the early Jesuit writers and at the same time ignoring the results of modern research, which has shown how far Christian symbolism, ritual, and dogma were pagan and taken over from other religions. Our correspondent evidently has in mind references which have been made from time to time to the question of the existence of witchcraft as an organised religion opposed to the Church. It should, however, be obvious to those who have followed the recent literature that to seek for evidence of something more in witchcraft than either a mere 'survival' or hysteria and delusion does not necessarily involve either acceptance of the view of the medieval, or later, Roman Church or ignorance of the primitive or pagan elements in Christianity. Miss Murray, in "The Witch Cult in Western Europe", and other writers, working on anthropological lines, have built up the theory of a fertility cult which survived among the people. It extended to some of the ruling classes, who used it for their own ends; for example, Bothwell and Gilles de Rais. Miss Murray thinks that such individuals as these were the leaders who embodied the fertility god in an organised religion. In other words, Miss Murray thinks she has found the real facts which underlie the accusations of the Church. In a sense, then, she is 'orthodox'. If from time to time our reviewer has referred to evidence which might be held to support her view, it is rather because he must confess himself as, on the whole, a sceptic.

AT a meeting of the Section of Psychiatry of the Royal Society of Medicine, held at the Wellcome Historical Medical Museum on Tuesday, Nov. 12, the president, Sir Robert Armstrong-Jones, gave an address on superstition. Superstition, he said, is the encroachment of faith on the rights of reason. It is most often founded on ignorance and it is difficult to explain it among educated people. Psychologically, it is suggestion based upon the instinct of fear, although curiosity and the instincts of reverence and awe enter into it. In the sixteenth and seventeenth centuries it was heresy not to believe in witchcraft. Omens were

sought for everywhere, in the flight of birds, in the power of numbers, in rivers, and in the heavenly bodies. Many who admitted the influence of witchcraft were undoubtedly insane and were the victims of cerebral disorders, but were regarded as in the control of and possessed by demons. Some of those possessed suffered from a form of insanity described as *folie à deux* or communicated insanity, which spread like an epidemic of mental influenza all through Europe. In healing, the help of precious stones was elicited. There were healing stones—some with holes for the patient to pass through and some to be worn as talismans, or carried on the person as amulets or charms. The Royal 'touch' also had healing virtues. Probably the expectation and pleasurable hope of cure helped to raise the bodily resistance to disease by increasing the activity of the vital functions. Ancient customs and maxims have to-day lost their cogency, and Pavlov's experiments, with other researches, have shown that an idea can cause changes in the blood just as the secretions of the ductless glands can vary ideas. With the passing of superstition, the treatment of insanity has been revolutionised.

In a recent lecture at Oxford, General Smuts spoke hopefully of the settlement of areas in tropical Africa by the races of Europe. In this connexion the conclusions on acclimatisation reached by Prof. R. de C. Ward, after a prolonged study of the evidence, are of interest. Prof. Ward discussed the subject in a lecture which is published in part in the *Scientific Monthly* for August 1929 and in full in the *New England Journal of Medicine* for Sept. 26, 1929. Prof. Ward pointed out that true acclimatisation concerns not the individual alone nor even one generation. The real problem is the maintenance through generations of the physical, mental, and moral standards of their former homes; in short, the maintenance of civilisation on a plane no lower than that of the home countries. This entails the continuance of a birth-rate higher than the death-rate. Prof. Ward concludes that though many tropical diseases may be fought and mastered, the ill-effects of the climate still remain. He foresees life in the tropics becoming more comfortable as well as safer for the white race, but maintains that in the light of our present knowledge true acclimatisation is and will remain impossible.

Since the publication of Dr. F. Sherwill Dawe's letter, "The Comma Butterfly in England", in Nature of Oct. 26, 1929, p. 653, we have received other communications on the subject. Mr. J. Evershed, Highbroom, Ewhurst, Surrey, states that he knew the comma butterfly in North Wales so long ago as 1874, but during a motor tour, including the Wye valley, towards the end of July of this year, he did not see a specimen. On Sept. 11, however, he discovered a perfect comma in his garden on the south-east slope of Pitch Hill. Mr. Ernest J. Lay, Jesus College, Oxford, records that he has taken specimens of the comma butterfly in recent years, and notably in Wychwood Forest on Easter Monday 1927. He has also taken it in the north of Berkshire, and about the middle of August 1928 and 1929 in Dorset near Lyme Regis. Mr. G. T. Harris, Splatt Hayes, Buckerell, Honiton, Devon, refers to the appearance in his garden during September 1928 of two commas in perfect condition.

One of the problems of modern life which is becoming more and more important is the invention of methods to diminish the noise sometimes emitted by machinery and electrical apparatus. It is necessary, however, if scientific progress is to be made, to be able to measure the 'noise' emitted by a machine. The measurement of 'street noise', for example, has been spasmodically attacked by scientific workers for many years with the object of fixing limits to these noises and securing definite evidence in any particular case of its magnitude. Some progress seems now to have been made. In a paper read to the Institution of Electrical Engineers on Nov. 7, B. A. G. Churcher and A. J. King described experiments that they have carried out on the measurement of the noise emitted by stationary machinery. This is a necessary preliminary to more complete experiments on running motor vehicles. A car, for example, might be driven round a circular track at a constant speed with a central microphone always pointing towards it. In this way, noise 'pass limits' could be fixed and border line cases judged on a definite quantitative basis. The apparatus used by Messrs. Churcher and King consisted of a microphone, an amplifier, and an analyser. As sine wave generators giving frequencies up to 2000 cycles per second were available, the apparatus could be accurately calibrated. König's formula was utilised, as experiments with Rayleigh's disc shows that it is accurate. The dimensions of the microphone were taken into account, experimental results having been obtained in the non-reflecting room of an acoustical laboratory. Numerical examples were given of tests on a small motor, on a large turbo-alternator, and on a horn type loud speaker. An attempt has also been made to assess total noise when several tones are present.

Damage caused to wild life by the rapid traffic of motor-cars has been the subject of several cursory investigations. The latest is a report by a member of the State Department of Agriculture of California, who, according to the Automobile Club of Southern California, counted 255 dead bodies during a trip of 632 miles. Twenty-nine species were represented, and the animals included 43 mammals, 144 birds, 40 reptiles, and 28 domestic fowl. Though the numbers seem large, they are but an insignificant fraction of the wild life in the region traversed, and the motor-car can scarcely be said yet to have gained a place in the ranks of the species exterminators.

The Report of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne for 1928–29 marks the passing of one hundred years since the Society was founded. This effort of William Hutton, the geologist, a leader among the founders, has had great influence in turning the characteristic regard of the people of the north-east for Nature, into scientific channels. One of the most important of the scientific outlets has been the establishment and

upkeep of the Hancock Museum, and the report before us shows that there the year has been marked by good progress. Rearrangement of the mammal and ethnographical exhibits has been completed, and a magnificent bequest by the late Abel Chapman adds to the collections a fine series of big game heads, birds' skins and eggs, together with a sum of £500 for their proper exhibition. The membership of the Society shows a slight decline on the year, at 596, but the local interest aroused by the centenary celebrations ought to give a fillip to the Society's interests. It is strange that the North-East Coast Exhibition, instead of attracting fresh visitors to the Museum, is said by the report to have been responsible for a slight falling off in numbers.

THE project of a tunnel under the Straits of Gibraltar to link the railways of Europe and Africa has reached the stage of preliminary investigations on the Spanish side. The scheme, in which the Spanish government is interested, was proposed by Lieut.-Col. P. Jevenois. It was recently expounded in an address ("El Tunel del Estrecho de Gibraltar") to the Real Sociedad Geografica by Senor D. Rafael de Buen, of the Spanish Institute of Oceanography. The narrowest part of the straits is eight miles wide, but the depths there are great and the nature of the rock precludes the possibility of boring. The site that has been chosen lies some eleven miles west of Tarifa at the broader western end of the straits, where a preliminary shaft has been sunk. The proposed route follows a curve to the south-west in order to avoid the deeper channel of the narrows and terminates near Punta Altares in the Spanish Protectorate. A tunnel on that course would be a little more than twenty miles in length and would dip at its lowest point to 1500 ft. below sea-level. From the preliminary shaft it is proposed to explore by means of sound waves the consistency of the rock. At the same time a detailed oceanographical exploration of the straits is to be undertaken.

THE annual report of the executive council of the National Institute for the Blind for the year ended March 1929, recently issued, is a publication calculated to stimulate interest in work for the blind. The task of supplying sightless readers with books is undertaken by the Institute, and the Braille presses—capable of printing 24,000 sheets an hour—have been working to capacity, and blind readers now have at their disposal works in almost every class of literature. When special books on a particular subject are required, for example, by a student, a band of voluntary workers undertake the task of transcribing by hand into Braille. Maps, music, games, and writing and other appliances are also issued by the Institute. It is to be regretted that the income for the year is less by £7000 than that of the previous year, and additional donations and subscriptions are needed to continue, and if possible expand, the present work.

IN the November number of *The Realist*, under the title of "Meteorological Science To-day", Sir Napier Shaw contributes an interesting review of the general history of meteorology from the earliest known times up to to-day. This article has all the breadth of outlook and refinement of expression that we have been accustomed to expect from the former director of the British Meteorological Office, and, as is the case with nearly all his writings, the reader is left with the feeling that meteorological research is worth while and is leading somewhere. The following landmarks in meteorological history are noted: (1) The appearance of Aristotle's "Meteorologica". (2) Toricelli's invention of the barometer. (3) The first synoptic weather maps about the middle of last century. (4) The organised study of the upper air by means of kites and balloons. (5) The recent extension of upper air research to frequent direct personal observations, made possible by the rapid progress of aerial navigation.

SIR NAPIER considers that of these five landmarks the third is the most important, but beyond an extension of the area covered by such maps and an increase of their accuracy and of the amount of detail that they include, they have not advanced much in nearly eighty years, and we are asked to consider carefully whether the maps that the meteorologist draws are the most informing that can be drawn. It is pointed out that Prof. V. Bjerknes and others have for many years doubted it, and would prefer to work with lines of flow at the surface, with lines of equal real pressure —as distinct from the imaginary pressure obtained by reduction of real pressure to sea-level—and with lines of equal density, which give information about the energy of the air.

SIR NAPIER SHAW'S hopes of more rapid advance in meteorology, and presumably in weather prediction, appear to centre round the possibility of effective use in synoptic weather maps of the 'entropy' of the air. Followed sufficiently far back, we doubtless come to communication of heat by radiation as the initial factor controlling weather processes, and as the entropy of any element of the atmosphere cannot be changed without an actual transfer of heat, we have here a quantity that is clearly of fundamental importance in the scientific treatment of the thermodynamics of the atmosphere. But, as the author points out, entropy is not everybody's toy, and he does not expect the appearance of the Kepler of atmospheric movements until much more has been done to foster meteorological study in the universities.

THE Croonian Lecture of the Royal Society will be delivered on Thursday, Nov. 21, by Prof. J. P. Hill, professor of embryology at University College, London. Prof. Hill will take as his subject "The Developmental History of the Primates".

PROF. H. FREUNDLICH, of the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry, will deliver the second Liversidge Lecture of the Chemical Society on Dec. 12, taking as his subject "Surface Forces and Chemical Equilibria". The lecture will be given in the hall of the Institution of Mechanical Engineers.

AT the anniversary meeting on Nov. 5 of the Mineralogical Society, the following officers were elected:—*President:* Dr. G. T. Prior; *Vice-Presidents:* Sir John Flett, Dr. G. F. Herbert Smith; *Treasurer:*

Mr. F. N. Ashcroft; *General Secretary:* Mr. W. Campbell Smith; *Foreign Secretary:* Dr. J. W. Evans.

AT the annual general meeting of the Cambridge Philosophical Society the following elections were made:—*President*: Mr. G. Udny Yule; *Vice-Presidents*: Prof. H. Lamb, Prof. S. J. Hickson, Prof. A. Hutchinson; *Treasurer*: Mr. F. A. Potts; *Secretaries*: Mr. F. P. White, Mr. W. B. R. King, Dr. J. D. Cockcroft; *New members of the Council*: Mr. E. B. Moullin, Dr. F. H. A. Marshall, Mr. J. A. Ratcliffe, Dr. E. K. Rideal.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant works manager of the Metal and Steel Factory, Ishapore, near Calcutta (an Indian Ordnance Factory)—The Secretary, Military Department, India Office, S.W.1 (Nov. 23). A lecturer in botany in the University of Edinburgh—The Secretary, The University, Edinburgh (Nov. 26). Assistant lecturers in, respectively, electrical engineering and commercial subjects at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (Nov. 26). An Andrew Simons research scholar in science at the University College of the South-West of England—The Registrar, University College of the South-West of England, Exeter (Nov. 29). A temporary assistant lecturer in geography in the University of Manchester—The Registrar, The University, Manchester (Nov. 30). An assistant lecturer (agricultural engineering) in the Department of Agriculture of the University of Leeds—The Registrar, The University, Leeds (Dec. 4). A lecturer in electrical engineering at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 6). An assistant director of examinations under the Civil Service Commission—The Secretary to the Civil Service Commissioners, 6 Burlington Gardens, W.1 (Dec. 6). A professor of physics in the Transvaal University College—The Principal, Transvaal University College, Pretoria, South Africa (Jan. 23). A Martin White professor of sociology at the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 24). A marine biologist in the Coastguards and Fisheries Service of the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. A lecturer in mathematics at the Warrington Training College, Liverpool—The Principal, Warrington Training College, c/o St. John's College, Battersea, S.W.11. A lecturer in mathematics at the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan. A full-time lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. An appointment on the technical staff of the Imperial Bureau of Animal Health—The Deputy Director, I.B.A.H., Veterinary Laboratory, New Haw, Weybridge. A county veterinary officer under the Somerset County Council—The Clerk of the County Council, Ashcombe House, Milton Road, Weston-super-Mare.

Our Astronomical Column.

Apparent Recessional Velocity of Distant Objects.—In view of the large spectral shifts found at Mt. Wilson and elsewhere for the spiral nebulæ, which appear to increase with distance, Prof. A. Belopolsky examines in *Astr. Nach.*, No. 5662, how far the spectra of stars in our own sidereal system exhibit the same phenomenon. He has divided the stars into three groups according to spectral type: 1000 stars of types *FGK*, the mean distance of which was 50 parsecs, gave a mean recessional speed of 0·1 km./sec.; 700 stars of type *A-M*, mean distance 100 parsecs, gave a speed of 1·4 km./sec.; 300 stars of type *B*, mean distance 200 parsecs, gave a speed of 5 km./sec. Since the spirals indicate a recession of 500 km./sec. at a million parsecs distance, the values found for the stars are too large in proportion, but they are in the right direction. It had already been noticed by others that the *B* stars show a general recession (the so-called *K* term); the value given above is probably too large to be wholly due to the 'distance-effect'. If Belopolsky has correctly estimated their distance, the effect, if it varies as the distance, would be only 0·1 km./sec., instead of 5.

A Catalogue of Dynamic Stellar Parallaxes.—It has long been the custom for computers of the orbits of binary stars to give at the conclusion of their work a statement of the parallax of the system on the assumption that its mass was equal to that of the sun, or alternatively that each component was of that mass. But until recently so little was known of stellar masses that the resulting parallax was not regarded with any confidence. However, since the recognition of the close correlation between a star's mass and its output of light, and the publication of Prof. Eddington's curve of the one as a function of the other, it was recognised that this is really quite a powerful method of determining stellar distances.

No. 930 of the *Astronomical Journal* contains a catalogue of the dynamical parallaxes of 1777 double stars by Prof. H. N. Russell and Charlotte E. Moore; Eddington's curve is used for calculating the mass. Since it is the cube root of the mass that enters into the parallax, it is clear that approximate values of the mass suffice to give parallaxes of fair accuracy.

The method can be applied even where the data are insufficient for an orbit, provided the curvature of the relative path can be measured; Prof. Russell considers that even in these cases the parallax is comparable in accuracy with the spectroscopic one; where a good orbit can be deduced, the dynamic parallax is entitled to considerable weight. 136 of the stars in the catalogue have had orbits computed; since those with large parallaxes were already used in deducing Eddington's curve, naturally their parallaxes reproduce the accepted values. The values given for Castor and Gamma Virginis are 0·081″ and 0·080″. Among the stars lacking computed orbits the following may be quoted: Polaris, 0·0041″; Aldebaran, 0·049″; Gamma Leonis, 0·021″; Alpha Herculis, 0·0057″; 61 Cygni, 0·36″. The results are given to two significant figures whether the parallaxes are large or small. The relative uncertainty does not greatly increase with the distance; but it does so to some extent, since distant objects have shorter arcs and the curvature is more difficult to measure.

Research Items.

A 'Basket-Maker' Site in New Mexico.—An unnamed village in Chaco Canyon, New Mexico, discovered by the Pueblo Bonito Expedition in 1926 while investigating Pueblo culture, was explored by Mr F. H. H. Roberts in 1927 (*Bull.* 92, Bureau of Amer. Ethnol.). It obviously belonged to a cruder and less highly developed culture than that of the Pueblos. From the proximity of a Navajo sun symbol and the customary mode of reference of the Navajo workman to "sun picture place", the site has been called "Shabik'eshchee Village". The village as uncovered consisted of the ruins of 18 dwellings, a kiva, court, and 48 storage bins. The houses had been substantial, though crude. They consisted of a pit, circular, oval, or rectangular, roofed with a pole, brush, earth, and plaster superstructures. The earth walls of the pit had been covered with plaster or stone faced, in the latter case the stone being covered with plaster. Four posts supported the superstructure, against which had rested small poles with lower ends embedded in the earth and forming the sloping upper wall of the house. Near the centre of the house was a fire-pit, and near by was a small circular hole, which is thought to be analogous to the mythical place of emergence of the ancestors from the under to the upper world of the earth. Most of the houses had a doorway from the main room opening on to a passage or antechamber. Not all the houses were contemporary, and there appears to have been a break in occupancy after a conflagration in the ceremonial chamber. The methods of construction show signs of a transition period. The material culture is represented by objects of pottery, bone, stone, and a little shell. The pottery is crude and is of grey, brownish white, white, or orange-red. Ornamentation is confined to painted decoration on bowls and table-ware. The patterns are simple and suggest basketry. The bone implements show considerable variety—awls, punches, bodkins, and scrapers. There was no definite cemetery. Bodies were placed on the back, head to west, with knees flexed. Mortuary offerings were found in three graves only. The inhabitants belonged to a long-headed group, and agree in physical type with that of the Basketmaker period.

Unusual Northward Movement of Marine Life in Pacific Ocean.—During the season of 1926, certain kinds of fishes and marine invertebrates occurred well north of their usual range on the north-west coast of North America. Amongst the latter were specimens of *Velella*, and the former included American species of sun-fish, anchovies, hake, Jack smelt, and others. By far the most telling evidence of northern movement, however, was furnished by the fishery statistics of the albacore. Carl L. Hubbs and Leonard P. Schulze show that whereas in normal years the fishing off southern California yields from 13 to 29 million pounds of albacore, that off Central California once gave 5000 pounds, and generally produces nothing (*California Fish and Game*, vol. 15, 1929; p. 234). In 1925, however, the latter fishery yielded roughly 450,000 pounds, and in 1926, 118,000 pounds. The authors think that the unusual northward occurrence of these southern forms of marine life along the Pacific coast in 1926 may be attributed to the warmth of the preceding winter and spring, following the rather warm summer of 1925. The southern forms which had wandered northward in 1925 were probably able to maintain themselves to an exceptional degree over the unprecedentedly warm winter of 1925–26, and then rapidly spread northward during the spring, when the ocean temperatures were verily summer-like. The occurrence has some resemblance to the drift of warm Atlantic water which in certain years brings representatives of the Atlantic fauna into the northern North Sea.

Parasites and Periodicity of Locusts.—The part played by viviparous flies in regulating the periodicity of locusts was discussed for the first time by an American entomologist, Riley (1878). It was assumed that infected locusts undertake lengthy migrations to get rid of these parasites and thus preserve the continuity of the species. Although this problem has never been made the subject of really serious study, this view was supported by several other authors. A Russian entomologist, N. G. Olsoufiev, has now made a careful study of the balance of the parasites and hyperparasites of *Locusta migratoria* L. (*Reports on Applied Entomology*, **4**, No. 1, Leningrad, 1929). As a result of researches extending over two years, and in the course of which 14,387 specimens of locusts were dissected, he comes to the following conclusions: The part played by parasites is of no significance to dense and large migrating swarms of either adults or hoppers, owing to a low percentage of infection, and the parasites can act as efficient controlling agents only in cases of swarms that have been thinned out by other agencies. During the period of oviposition, a high percentage of infection of female locusts by flies may be observed (up to 48 per cent). This fact, however, has no practical significance, since the presence of parasites diminishes the productivity of females by not more than 14 per cent. The error of ascribing to parasites the part of principal stimulating agents in the migration of locusts is shown by the fact that many species of Acrididæ regularly parasitised do not migrate at all. Again, *Blæsoxipha lineata* is specially adapted for parasitising flying locusts. Finally, the migrations do not enable the locusts to escape the parasites, for the latter migrate with them. The viviparous flies cannot be regarded, therefore, as a factor regulating the periodicity of outbreaks of *Locusta migratoria* L., and the problem of periodicity should evidently be approached from other viewpoints.

Pelagic Freshwater Cladocera.—Dr. R. Woltereck, who has worked much on the Cladocera of lakes, gives a long survey of researches relative to specific environment, zoning and migrations, and the significance of certain body outgrowths in the freshwater forms (*Biologische Zentralblatt*, Bd. 48, Heft 9, 1928). The natural food of these Cladocera is the nannoplankton, especially algæ. Specifically different races live in different lakes, and each lives in a specialised zone which may be defined both vertically and horizontally, making diurnal migrations to a definite extent. Various factors influence the migrations—phototropism, geotropism, temperature, the chemical nature of the water, sex, and age; also the food supply is probably to a certain extent the cause of such movement. Thus it is important to study the migrations, if any, of the consumed as well as of the consumers, and, as the present author points out, much more research is needed in this direction. The function of certain outgrowths in these freshwater Cladocera has been the cause of much disagreement among the various workers. Short-headed Daphnias live in the deeper water layers, the helm-bearing races in the shallower and surface layers. The helm and the horns in certain *Daphnia* and *Bosmina* species, according to some authorities, serve for suspension organs;

according to Dr. Woltereck they are stabilising and steering organs, which are usually present in addition to suspensory outgrowths. In his opinion, for example, the feathery bristles of the antennæ of *Daphnia* serve for suspension, the spine and helm for stabilising, the latter also for steering. We might quote as an analogous case the dorsal and rostral spines in the crab zœa, which have been shown by Wheldon to be used for directive purposes. In the last part of the paper the author discusses the relations between food algæ, Cladocera, and young fishes. The Cladocera which eat the nannoplankton algæ are themselves eaten by the young fishes and a definite system is established, the numbers of each being kept at a certain average; any alteration in numbers in any part causing a corresponding alteration in the rest.

Life-histories of Marine Trematodes.—Some very suggestive notes are made by Mr. O. R. McCoy on the hosts of marine trematodes (Year Book No. 27 of the Carnegie Institution of Washington, 1928, "Studies on Marine Trematode Life-Histories"). Little is known about the final and intermediate hosts of the many cercariæ described chiefly from the marine molluscs in the neighbourhood of the Tortugas Laboratory. In spite of the work already done, mainly by Prof. E. Linton, on adult trematodes, the author of these notes remarks that probably nearly half the fish trematodes of the Tortugas are still undescribed, many of them occurring in the small reef fishes. Feeding some of these latter with cercariæ from the molluscs resulted in many of them encysting in the fishes. Ten species of cercariæ were obtained from *Astræa americana* and *Cerithium litteratus*, the commonest gastropods on the reef. Eight of these were already known, two are new. Experiment failed to persuade any of these to encyst in invertebrates, but four species entered the small reef fishes. One from *Astræa*, designated Cercaria *A*, developed in the gray snapper *Neomœnis griseus* into the trematode *Hammocreadium mutabile*. This worm was found to encyst in small fishes known locally as 'grunts', 'snappers', 'slippery dicks', and 'parrot fish'. These small fishes were fed to gray snappers, and the growing trematode identified in the intestine and pyloric cœca. The life-history of *Hamacreadium mutabile* is thus—first host *Astræa americana*, intermediate host the small fishes mentioned above, final host the gray snapper. Three other cercariæ were found to penetrate small fishes.

A New Terrestrial Amphipod.—*Orchestia kokuboi* is the name given to this interesting new species described by Mr. Maruzô Uéno (*Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 4, No. 1, fasc. 1; 1929). Four females and one male were collected by Prof. S. Kokubo on a hill in Yu-no-shima, a small island off Asamushi (latitude about 40° 70′ N.). "This spot is far above the tide-marks; and the animals were found living in burrows in soft damp soil under dead leaves." The species closely resembles *Orchestia grillus* but with distinct differences in antennules, gnathopods and other features, especially in its long antennules, and in its gnathopods it resembles *Orchestia humicola*, another terrestrial Japanese amphipod, which is, however, much smaller and differs from the present species in other features also. *Orchestia kokuboi* is of fairly large size, measuring 18 mm. in body length in the male, 17 mm. in the female, exclusive of the antennæ.

Asphalt Emulsions.—The use of asphalt emulsions in bituminous road construction has been greatly extended in recent years, both in Europe and America. Although ordinary dry oils and asphalts are suitable under many conditions, they sometimes lack capacity to spread over wet surfaces or to adhere readily to broken stone. The problem is obviously accentuated by wet weather, and operators have been forced to recognise the claims of emulsified dressings. The asphalt emulsion generally employed is that of a fine suspension of the bitumen in water. It is found that the asphalt content of bituminous sands, for example those of Alberta, western Canada, is particularly susceptible to emulsification, so that with the growth of this process considerable impetus to this department of the oil industry should result. The asphalt emulsion is far more easily handled on wet surfaces than on dry; it is rapidly spread, and strongly coherent. Ultimately the water content evaporates, leaving behind a rigid asphalt coating, said to be as firm and lasting as if ordinary dry bitumen had been utilised. The advantages of using emulsions in this way are many, chief of which is the fact that the materials are fluid at ordinary temperatures whatever the viscosity or hardness of the asphalt employed in the first place; heat treatment is dispensed with, and thus one of the most objectionable factors to the commercial use of asphalt is overcome. Further work on these emulsions has shown that they are also valuable for water-proofing concrete structures; the question of adherence between asphalt and concrete is one of importance, but the main difficulties have been concerned with 'green' or damp concrete, on which it has always been hard to get adequate spread of the bitumen. The emulsion does away with this difficulty, and, as K. A. Clark shows in his recent report on the "Bituminous Sands of Alberta" (*Sci. Ind. Research Council Alberta*, No. 18, part 3, 1929), it can be applied cold just like paint, any number of coatings being feasible.

Origin of Helium-rich Natural Gas.—Helium is remarkable for its unusual facility in diffusing through glass and other materials. Williams and Ferguson have shown that at 500° C. the permeability of quartz-glass to helium is nearly thirty times that to hydrogen. R. C. Wells has pointed out the application of this and similar results to the problem of the origin of helium concentrations in natural gas (*Jour. Wash. Acad. Sci.*, Sept. 19, 1929). He writes, "We may suppose that when deeply buried rocks become heated, as they evidently have been during certain geologic epochs in some localities, helium would have a particular and special tendency to escape at one stage of the heating, say 200°, and if then collected and trapped by overlying impermeable barriers in a cooler environment, would constitute helium-rich gas". Wells directs attention to another process that similarly contributes to helium concentration. He has investigated the diffusion of hydrogen and carbon dioxide through the pores of ball-clay, and finds, in accordance with the principles first established by Graham, that in every mixture the first fraction that passes through is richer in hydrogen than the original mixture. He suggests that it is reasonable to suppose that helium will behave like hydrogen and that the process of diffusion is worthy of consideration as a preferential means of concentrating helium. Thus for the first time a reasonably satisfactory explanation is forthcoming for the presence of relatively abundant helium in natural gases from mines, springs, and earth-vents generally.

The System: Leucite-Diopside.—With the thermal investigation of mixtures of pure leucite and pure diopside, Bowen and Schairer have made a beginning in the theoretical study of the leucite-bearing igneous rocks (*Amer. Jour. Sci.*, October 1929, pp. 301-312).

They find the system to be of the simple eutectic type, both liquidus curves, however, being convex downwards instead of upwards, as is more usual. The eutectic is at 61·5 per cent diopside and the temperature is 1300° ± 2° C. Natural leucitites are much more complex and will be completely liquid at considerably lower temperatures. They will, moreover, on account of a notable content of soda, be affected to some extent by the complex reaction relations exhibited in the diopside-nephelite system. The inversion temperature of pure leucite is found to be 603° C. Grossmann has given that of Vesuvian leucite as 620° C. We have here a good indication of the minimum temperature of crystallisation of natural leucite, since the latter has always passed through the inversion. The internal strains set up during this passage may be a material aid to the thorough transformation of leucite to the intergrowth of orthoclase and nephelite known as pseudoleucite.

Natural Gas.—In the October issue of the *School Science Review*, Mr. J. Kewley, of the Asiatic Petroleum Company, gives an interesting account of natural gas from petroleum wells, which consists essentially of hydrocarbons of the paraffin series, methane predominating. This is produced in enormous amounts, and is not always utilised. At present 32 million cubic feet per day are uselessly burnt in Persia. New applications of the gas are, however, being found. In the United States this gas is supplied for heating purposes to industry and for making carbon black, which is obtained by the incomplete combustion of the gas and is used as a pigment and in the manufacture of motor tyres. The modern tyre contains about 30 per cent of carbon black incorporated with rubber, and this very greatly increases its resistance to wear. Another use of the gas is the extraction of volatile liquid constituents from it for blending with motor spirit. Ten per cent of this now comes from the natural gas. The very volatile constituents are stored in spherical tanks of large capacity, up to 1000 tons, called Horton spheres, and Mr. Kewley states that there is some prospect of the introduction of these tanks into Great Britain for the storage of coal gas under pressure. He considers that there is likely to be a considerable utilisation of natural gas in making synthetic chemical products, such as formaldehyde, alcohols, and acetone, for use in the rapidly developing cellulose paint and other industries.

Philips' Handy Theodolite.—This is a useful little instrument designed by Mr. G. C. Sherrin and made by Messrs. George Philip and Son, Ltd., and sold in a leatherette case at 17*s.* 6*d.* It consists of a strong moulded ebonite disc 4½ inches in diameter, around the centre of which moves a sighting arm with a pin-hole and V notch on both vertical ends. The rim of the disc is graduated to degrees. A link, attached to the circumference, allows the instrument to be held vertically for taking levels or in measuring heights. A movable counterweight makes it easy to adjust the centre of gravity. When the instrument is to be used horizontally, it stands on three firm feet or it can be screwed on to a stick or tripod by means of a simple ball-and-socket joint which is provided. The theodolite appears to be strong and well made and should prove useful in school work or any purpose connected with survey, levelling, measuring areas, etc., where extreme accuracy is not required.

Bunsen Flames of Unusual Structure.—The ordinary Bunsen flame consists, as is well known, essentially of two cones, the chemical reactions in which were investigated some time ago by Prof. Smithells. In a paper in the *Bureau of Standards Journal of Research* for July, F. A. Smith and S. F. Pickering describe some interesting experiments on flames of mixtures of oxygen or air with acetylene and propane burning in secondary air. The paper is accompanied by beautiful plates showing photographic reproductions of the flames, and these show clearly that in some cases complex structures make their appearance. When secondary air is excluded, the primary zones of some of the flames show a polyhedral structure. Flames having 3, 4, 5, 6, and 7 sides were observed, which rotated under some conditions and remained stationary in others. The number of sides is a function of the size of the burner tube and of the composition of the gas mixture.

Effect of Water on Chemical Reactions.—It has been known for some time that certain chemical reactions take place very slowly, if at all, in the absence of traces of water. The earlier experiments of Dixon and of H. B. Baker provided several interesting examples of this phenomenon. For example, a well-dried mixture of carbon monoxide and oxygen does not explode with a weak electric spark, and dry ammonium chloride does not dissociate on heating. In other cases, such as the union of mercury and chlorine, the presence of moisture has little effect. In *Science Progress* for October there is an article on this subject by G. R. Gedye in which recent work is summarised, and the theories proposed to explain the effects are discussed. It is concluded that effects of ionisation and of the surface of the vessel may both play a part, although in some cases, such as the union of carbon monoxide and oxygen, there are special mechanisms of a chemical character.

The Equilibrium $CO_2 + C = 2CO$.—A certain amount of evidence exists that this important equilibrium is in some respects dependent on the particular type of carbon with which the two gases are in contact. In the September issue of the *Journal of the Chemical Society*, Prof. J. W. Cobb and F. E. Dent describe some experiments which support this. They used graphite, coke, and charcoals, both with and without sodium carbonate, the latter being a catalyst for the reaction. The results show that the percentage of carbon dioxide in the equilibrium gas at 800° C. may vary from about 7 to nearly 14, the higher figure corresponding with graphitic carbon and the lower figures with carbons containing some active unsaturated atoms of carbon. Since charcoal containing unsaturated atoms is slowly converted into graphite on heating, the figure for the apparent equilibrium will vary according to the extent to which this change has occurred. The reverse reaction is expected to vary in the same way.

Optical Isomers.—An X-ray examination of the *d*-, *l*-, and racemic forms of phenylaminoacetic acid has been made by Clark and Yohe, whose results are described in the September number of the *Journal of the American Chemical Society*. The *d*- and *l*-forms were shown to crystallise in the orthorhombic system, in a lattice and group admitting of no molecular symmetry. This confirms the fundamental theory of van 't Hoff and Le Bel connecting molecular asymmetry with optical activity. Only X-ray measurements by the rotation method were used, and these gave a possibility of the crystal analysis without any crystallographic or optical data. It was not possible to distinguish between the *d*- and *l*- forms by means of X-ray diffraction methods. The crystal modification of the racemic form differs from that of the optically active forms.

Egyptian Medicine.[1]

By WARREN R. DAWSON.

IF we wish to go back to the very beginnings of the great science of medicine that to-day can almost achieve miracles in the prevention and cure of disease, it is to Egypt that we must turn, for the Egyptian medical books are by many centuries the oldest scientific writings that have survived the ravages of time. Our knowledge of Egyptian medicine is derived from a series of papyri, the oldest of which dates from the Middle Kingdom, although all of them are clearly derived from much more ancient prototypes. These papyri for the most part are miscellaneous collections of prescriptions and incantations for the cure of diseases of many kinds, and they contain but little information to enlighten us on Egyptian conceptions of anatomy and physiology.

The ancient practice of mummification, which began probably so early as the time of the First Dynasty, has had an enormous influence on the growth of anatomical knowledge, for the complex manipulations to which the body of an Egyptian was subjected in the course of its embalming afforded opportunities for many centuries for its practitioners to become acquainted with the nature and mutual positions of the internal organs of the body—opportunities that were denied to all peoples who inhumed or cremated their dead. Mummification, involving as it did the removal and handling of the internal organs of the body, provided the first opportunities for observations on comparative anatomy, for the Egyptians did not fail to perceive the essential identity between the organs of the human body and those of animals, the latter long familiar from the time-honoured custom of cutting up animals for sacrifice and food. The effects of these observations are seen in the fact that the Egyptians had a very extensive anatomical vocabulary. They were able to distinguish and name a great many organs of the body that a more primitive and less enlightened people would have grouped together or failed to perceive. They were consequently able to localise many diseases and ailments, since they knew the positions and general character of the internal organs.

Of all the viscera the heart was regarded as the most important. The Egyptians apparently attached no importance to the brain, but the heart was regarded as the seat of life and consciousness and of the emotions. It was further recognised as being the centre of a complex series of ' vessels ', although the Egyptians failed entirely to understand the vascular system and the nerves and muscles; yet they understood the pulse and diagnosed any irregularities of its beat as being caused by affections of the heart. It is further significant that the heart was always carefully left in its place in the thorax, attached to its great vessels, when all the other viscera, both of the chest and the abdomen, were removed in the process of embalming. The presence of the heart was believed to be as important to a mummy as it was to a living man.

The Egyptians shared with many other primitive peoples the belief that death and disease are unnatural and abnormal. Disease had a cause that was impalpable and invisible, and it was generally laid at the door of supernatural influence. The paramount belief that illness was due to possession is clearly expressed in the Egyptian papyri. Many of the diseases are expressly stated to be " the assaults of a god, the assaults of a goddess, of a dead man or a dead woman, of an enemy, male or female ", etc. In the papyri the idea of possession is evident from the fact that the diseases are often treated as if personified, and they are addressed and harangued by the magician. The titles of the prescriptions clearly embody the same idea, for we find, instead of the simple phrase " prescription for *curing* " such and such a disease, the words " prescription for banishing ", " driving out ", " expelling ", or " terrifying " the disease.

There cannot be the slightest doubt that Egyptian medicine had its origin in magic, and that magic never lost its hold upon medicine, even when the latter was becoming more and more rational. The earliest doctors were magicians and the earliest forms of treatment were magical rites. Some of these rites were merely oral; the magician recited a spell and bade the possessing devil to be gone. Others combined with the oral rite a manual rite, in which the spoken formula was recited to the accompaniment of some gesture or manipulation. Spells were recited over amulets, and the amulets were then placed upon the affected part. Sometimes, again, the recitation was made over some herb or mixture of substances, which, when charged with magical power, was administered to the patient either as an external or internal medicine. Thus arose the practice of giving the patient a prescription of drugs, often nauseous in character, the primary object of which was not so much to relieve the sufferer as to expel the demon of disease.

It is characteristic of the magician that he should have more than one string to his bow: if one remedy should fail, another may succeed, and consequently the papyri are full of alternative prescriptions for the same disease. Their very multiplicity is a confession of their purely arbitrary and unscientific character; but it often happened that some of the prescriptions really did contain elements that were appropriate and rational, and these consequently would tend to supersede their worthless fellows, and, as a result, the magician who could compound effective medicines was most in request. Such magicians were, in fact, no longer magicians, but physicians.

It will thus be seen that, through a long process of more or less ineffectual experimenting, the Egyptians groped their way towards a rational pharmacopeia, and this, combined with their knowledge of anatomy, crude and unscientific as it was, enabled them to prepare prescriptions for the treatment of disease seated in various localised parts of the body centuries before other nations, that lacked such knowledge, were able even to begin to understand medicine. The other nations of antiquity borrowed from the Egyptians, ready-made, the foundations of their medical knowledge, and the early medical literature of many other countries, not excepting Greece, bears abundant testimony to the debt owed to Egypt.

Wounds and injuries were regarded by the Egyptians in quite a different light from sickness and disease. The cause of the latter was invisible and unknown and attributed to supernatural influence, whilst the foeman's axe or other human energy was the easily perceived cause of the former. Wounds were consequently treated by rational means, and with their treatment, surgery came into being. Gradually, the morbid conditions that were often revealed by wounds were observed in cases where no wounds had been inflicted, such as in cases of boils and suppurating sores, and thus rational surgical methods were adopted for the treatment of these cases. Many of the passages that describe the treatment of wounds and diseases

[1] Paper read at a reception to the president, committee, and members of the Egypt Exploration Society, held at the Wellcome Historical Medical Museum, on Nov. 11.

that had some obvious external manifestation are strikingly rational and thorough, but although rationalism and experience were enabling scientific medicine to free itself from the shackles of magic, the latter nevertheless continued, and it is by no means extinct to-day. Even when he treated disease by rational therapeutic methods, the physician could never forget that his art originated in various attempts to coax, charm, or forcibly expel the demon of disease from its involuntary host.

It is the fashion amongst students of medical history to despise Egyptian medicine as fantastic and absurd. It must not be forgotten, however, that through the thirty centuries or so that preceded the birth of scientific thought in Greece, Egypt had painfully laid the foundation upon which later investigators were to build. Throughout the jumble of magic and sorcery that plays so large a part in Egyptian medicine, a careful study of the texts reveals a modicum of correctly observed truth—the very foundations of medical science. If Egypt cannot compete with Greece in scientific knowledge and thought, she at least inaugurated what others have developed, and the time-honoured custom of mummification familiarised the popular mind for thirty centuries with the idea of cutting the dead human body, and the Greek anatomists in the time of the Ptolemies were able to begin, in Egypt, the systematic dissection of the human body, which popular prejudice forbade in all other parts of the world. Without anatomy, the scientific practice of medicine could never have been possible: civilisation and humanity owe an enormous debt to Egypt.

Origin of the Bird Fauna of the Arctic.

AN attempt to solve the problem of the origin of the bird fauna of the arctic has recently been made by Prof. A. Tougarinov ("The origin of Arctic Fauna", *Priroda*, No. 7-8, 654-680, Leningrad, 1929).

The total number of species nesting in the arctic zone is about 180, or 240 if one includes the sub-species. These can be divided into the following zoogeographical groups:

(1) The group with circumpolar distribution, comprising 26 purely arctic species, which do not nest farther south. It is interesting to note that there exists a distinct systematic affinity between some of these species and those inhabiting more southerly regions. Thus, the arctic *Buteo lagopus* is closely related to *B. hemilasius*, which inhabits Central Asia and is not found farther north than the southern regions of the Siberian steppes. Many other such examples might be quoted.

(2) The Atlantic group, consisting of 16 species, out of which 7 are truly arctic, nesting on the coast-line of the Atlantic ocean. These species are found throughout the European coasts of the Atlantic, up to the regions which are subject to the influence of the Gulf Stream, Franz-Joseph Land, Spitsbergen, Iceland, Greenland, as well as the eastern coasts of arctic America.

(3) The European-Siberian group consisting of 15 truly arctic species, which are found throughout the tundras of Europe and western Siberia so far east as Taimyr. As a general rule, these species hibernate in the Mediterranean region, not farther east than the Aral Sea.

(4) The Eastern-Siberian group, which consists of 23 arctic species and is spread throughout the tundras and islands of the Polar Sea, from the Taimyr Peninsula up to the Kalyma River. Here again there is an affinity with more southerly Asiatic species. Thus, *Leucosticte brunneinucha* living in the tundras of Yakutia belongs to the genus well represented in the mountainous regions of Central Asia. Again, *Sarcogeranus leucogeranus* found in the tundras of Yana and Kalyma is sporadically distributed throughout the South Siberian, Mongolian and Kirgiz steppes. Even more striking is the close systematic affinity between the arctic species belonging to the East Siberian group and those inhabiting the nearctic, for out of their total number of 23, 11 species are found in North America.

(5) The Tchukotsk Peninsula group, possessing a rich and varied arctic fauna. There are 34 truly arctic species alone, out of which 12 are found also in Alaska, and another 15 in Alaska and America. The bird fauna of the Tchukotsk Peninsula bears a close resemblance to that of the neighbouring regions of America. On the other hand, one is struck by the dissimilarity between the arctic bird faunas of eastern Siberia and that found west of Chaunsk Bay; however, it is somewhat difficult to decide whether the Tchukotsk group belongs to the palæarctic or nearctic zoogeographical region.

(6) The bird fauna of the coast-line and the islands of the Bering Sea deserves to be placed in a separate group. It is distinguished by the presence of numerous representatives of the family *Alcidæ*, eight species of which are found in that region. Another characteristic of this fauna is its endemic character—there are 9 truly polar species which are not found outside the coast-line and the islands of the Bering Sea (for example, *Sterna aleutica*, *Erolia ptilocnemis*, *Leucosticte griseinucha*, *Philacte canagica*, etc.).

(7) The Alaskan group, which spreads so far east as the Mackenzie River, is distinguished by its great variety; it included 66 species and forms, out of which 36 can be considered as truly arctic. The American species predominate and 22 species and sub-species are endemic.

(8) The American arctic group inhabiting the region from Mackenzie River up to Baffin Land and Labrador. Out of 45 species nesting there, 30 are truly arctic. The majority of these are found in Alaska, 3 species belong to the Atlantic group, another 3 can be considered as endemics of Baffin Land, and one, *Micropalama himantopus*, has so far been found only in the Canadian tundras.

(9) The Greenland group, which besides the circumpolar species possesses 12 arctic ones. Of these, the majority belong to the European-Atlantic group, while the nearctic is represented by *Chen nivalis* and *Limonites fuscicollis*. There are no endemics.

The above facts permit of the following conclusions:

The bird fauna inhabiting the arctic region of eastern Siberia has apparently been derived from Central Asia. The fauna of the European-Siberian part of the Palæarctic is not closely connected with that of the Atlantic region, but has a distinct systematic affinity with the fauna of eastern Siberia (for example, *Erolia*, *Branta*, *Limosa*). It can be considered, therefore, that the tundras of western Siberia and Europe are inhabited by immigrants from the East. Many American species are found in European Siberia, and although some Siberian species are found in America, they are not so numerous and have spread only so far as western Alaska.

The region of the Bering Sea, which includes the Tchukotsk Peninsula and Alaska, is inhabited by a peculiar fauna of its own, possessing numerous ancient forms. Its water fauna is original and its land fauna is connected with that of America. It is probable,

therefore, that the bird fauna of arctic America originated in this region.

A number of species inhabiting the tundras are derived from the southern Palæarctic, most likely from the modern Kirgiz steppes; their dispersion took place probably along the Turgaisk-Barabinsk plains.

It follows, therefore, that the arctic bird fauna is derived from two distinct centres, namely, eastern Siberia and the region of the Bering Sea. The species derived from eastern Siberia spread throughout the palæarctic; only a limited number reached America. The arctic fauna of America and some species found in extreme eastern Siberia have been derived from the region of the Bering Sea.

The other centres of lesser importance where certain arctic species originated and whence they spread are the coast-line of the Atlantic Ocean and Central Eurasia, probably the modern Kirgiz steppes. The Atlantic bird fauna was formed on the Atlantic coast-line simultaneously with the spreading farther north of warm ocean currents, and from there it spread over the neighbouring continents. The immigrants from southern Eurasia spread through far-eastern Siberia, which they reached by way of the west Siberian plains.

Forestry Research in India.

THE recent announcement in the *Times* of Nov. 8, that the Viceroy, accompanied by Lady Irwin, had opened at Dehra Dun the new Government Forest Research Institute, the largest in the British Empire, if not in the world, is of considerable interest. Early in 1926 it was announced that the Finance Committee of the Legislative Assembly had sanctioned a sum of £833,000 to be spent on the Research Institute. This announcement was discussed in NATURE (Feb. 6, 1926, p. 204). The new buildings just opened by the Viceroy are stated to have cost the sum of £850,000.

Dehra Dun has been the centre of forest education since 1878, when a training college for rangers and foresters was established. Towards the end of 1900 the first research work by the Forest Department was commenced, when a member of the forest staff was appointed for two years as forest entomologist to the Government of India with headquarters at Dehra Dun. This appointment was renewed in 1904, the same officer taking up the post. The question of the formation of a Research Institute was then taken up actively, the sympathy and support of Lord Curzon, the Viceroy, was secured, and the Research Institute with a sanctioned staff, but without adequate buildings or equipment, came into being in 1906.

The new department expanded rapidly and the first Institute buildings were opened in 1914. The War brought about a great opportunity and created a demand for the maximum utilisation of all kinds of Indian forest products. The buildings, deemed adequate in 1911, proved far too small, and the Industrial Commission of 1918 strongly urged the need for extending the Research Institute, its equipment and staff. Effect was given to this suggestion. The Government of India took up an area of 1200 acres of land on the outskirts of Dehra. The Central Institute, with separate buildings for mills, workshops for sawing, testing, and seasoning timber, laboratories, offices, and residences for the staff, are now complete. The main Institute building, with its already splendidly developed series of museums and its library and laboratories, is 1024 feet long and 285 feet wide, and has two stories, Indian timbers having been largely used in construction work, panelling, etc.

Preparatory to the completion of the building, the Government of India appointed a committee of business men to review the organisation of the Institute and to make recommendations for the maximum efficiency in its work. The committee reported very favourably in July last, and the Government has already discussed the proposals with the Inspector-General of Forests, Mr. A. Rodger. The latter warmly praised the recommendations of the committee. The Viceroy, in opening the new buildings, also paid a tribute to the work of the committee, and after describing some of the fine work already accomplished by the Research Institute, stated that the Government intended, within the limits of its financial liability, to give the Institute the scientific staff which it requires.

University and Educational Intelligence.

CAMBRIDGE.—The Adam Smith Prize has been awarded to R. F. Kahn, King's College, for an essay entitled "The Economics of the Short Period".

The Clerk Maxwell Scholarship for the advancement by original research of experimental physics, of the value of £210 a year for three years, has been divided equally between Mr. W. H. Watson, research student of Gonville and Caius College, and Dr. W. L. Webster, of Trinity College.

Mr. Sydney Goldstein, Smith's Prizeman 1927, Isaac Newton Student in the University 1927–28, has been elected into a fellowship at St. John's College.

LONDON.—The following doctorates have been conferred: D.Sc. in chemistry on Mr. H. J. Emeléus (Imperial College—Royal College of Science), for a thesis entitled "The Glow of Phosphorus and Allied Phenomena", and on Mr. I. Vogel (Imperial College—Royal College of Science), for a thesis entitled "Carbon Rings"; D.Sc. in medical and vital statistics on Mr. A. B. Hill (London School of Hygiene and Tropical Medicine), for a thesis entitled "An Investigation of Sickness in various Industrial Occupations"; D.Sc. (Engineering) on Mr. M. A. Hogan (Imperial College—City and Guilds College), for a thesis entitled "The Support of Underground Workings in Coal Mines"; D.Sc. (Engineering) in metallurgy on Mr. J. M. Robertson (Imperial College—Royal School of Mines), for a thesis entitled "The Effect of Variations in the Rate of Cooling on the Microstructure and Constitution of Steel".

The Sir John William Lubbock Memorial Scholarship Prize in mathematics, of the value of £30, has been awarded to Miss I. W. Busbridge, of Royal Holloway College.

READING.—Mr. James R. Matthews, lecturer in botany at the University of Edinburgh, has been appointed to be professor of botany in succession to Dr. W. Stiles, now professor of botany at the University of Birmingham.

THE Wigan and District Mining and Technical College, founded in 1857, gives particulars in its new and enlarged Calendar of the buildings opened for it last June by Lord Chelmsford. Their erection was made possible by grants amounting to £37,000, including £5000 for equipment, from the Miners' Welfare Fund. It is now in a position to offer full-time university degree courses in mining, engineering, chemistry, and general science, as well as in commerce and art.

We have recently received the Calendar of the Heriot-Watt College, Edinburgh, which provides day and evening instruction in mechanical, electrical, mining, and oil engineering, applied chemistry, brewing, pharmacy, building, printing, commerce, and languages. It is closely associated with the University of Edinburgh, and its courses form an essential part of the training of students for the University's degrees in civil, mechanical, and electrical engineering, mining and metallurgy, and technical chemistry. The mine rescue station for Mid and East Lothian is a portion of its mining department. Continuation classes in the south-east of Scotland, affiliated with its classes, are conducted by city and county education authorities.

The Council of University College, Cardiff, has executed a new agreement with the Cardiff Royal Infirmary regarding the Welsh National School of Medicine, and the School is therefore re-opening for students in the clinical departments this session. A joint Appointments Committee, on which the students are represented, has been set up by the Council and Senate. A course in general science, shared between all the departments of pure science and open to the public, has been arranged for the current session. Recent appointments include the following: Prof. J. F. Rees, to be principal in succession to Dr. A. H. Trow (retired); Mr. C. N. Strong to be lecturer and demonstrator in anatomy; Mr. J. B. Duguid to be acting professor of pathology and bacteriology.

"Progress of Education in India, 1922–27", by R. Littlehailes, Educational Commissioner with the Government of India (Calcutta, Govt. of India Central Publication Branch, vol. 1, R. 1.10 or 2*s.* 9*d.*, vol. 2, Rs. 2.10 or 4*s.* 9*d.*) is a review of noteworthy interest. This interest is the greater for the almost simultaneous publication of the report of Sir Philip Hartog's auxiliary committee appointed by the Simon Commission to present a review of the same subject (without limitation to the quinquennial period) in relation to political and constitutional conditions and potentialities of progress. This Committee's report directs special attention to the claims of girls' education, to which priority should, it says, now be given in every scheme of expansion. In this matter Mr. Littlehailes declares that the belief that "the education of women is essential to national advancement" is now widespread in India and holds that, in spite of many formidable obstacles, the outlook is brighter to-day than at any previous period. In sections on universities and intermediate education he traces the history of the attempts made to give effect to the policies advocated by the Calcutta University Commission's report of 1919. The separation of the intermediate classes (first half of the usual four years' course of higher education) from the university and the transfer of their work to 'intermediate colleges' would not, it is held, be academically sound without extension of the B.A. course from two to three years, and such extension is economically unacceptable if not impossible; the only provincial government prepared to accept the proposed separation is that of the United Provinces. The devolution policy of the constitutional reforms introduced in January 1921, with the transfer of responsibility for education from the Government of India to provincial governments, and the recent increase in the number and varieties of universities, has rendered increasingly difficult for outsiders the intelligent appreciation of Indian educational problems and especially university problems. Mr. Littlehailes' chapters on administration and control and on universities and colleges afford valuable help towards overcoming these difficulties.

Calendar of Patent Records.

November 17, 1884.—The foundation of the artificial silk industry was laid by Count Hilaire de Chardonnet, who patented his cellulose-nitrate process in France on Nov. 17, 1884. A factory was set up at Besançon, and manufacture started in 1891, and though Chardonnet's process has been outdistanced by the cheaper viscose method of production, the growth of the industry has been continuous from that time. Sir Joseph Swan's artificial thread of 1883 was used only for electric lamp filaments, and was not taken up for textiles.

November 18, 1820.—The first successful calculating machine to be manufactured on a commercial scale was patented in France by Franz Xavier Thomas on Nov. 18, 1820. The adoption of the machine was slow for many years, but by the middle of the century it was being manufactured in large quantities, and machines of the same type are still being made to-day. An original Thomas machine is in the Deutsches Museum at Munich.

November 20, 1772.—The Birmingham 'papier-maché' industry was founded by Henry Clay and was based on the patent granted to him on Nov. 20, 1772, for a process of making decorative panels, tea-trays, etc., by pasting sheets of paper together, and japanning or lacquering them. The term 'papier-maché', which had been used many years before in its real sense for articles made from moulded paper-pulp, was not applied to the articles made by the Clay process until the middle of the nineteenth century.

November 20, 1813.—The introduction of the vacuum-pan into the sugar manufacturing process—one of the most important inventions in the history of the sugar industry—was due to Charles Edward Howard, who was granted a patent for it on Nov. 20, 1813.

November 20, 1832.—The fusee match was patented by Samuel Jones of London on Nov. 20, 1832. The first friction matches were produced by John Walker of Newcastle-on-Tyne in 1826, but his invention was not patented and the fusee patent is the first for a friction match to appear in the records. Jones was the patentee also of the 'Promethean' match, one of the chemical 'instantaneous light' contrivances which preceded the friction match, and he also, in 1829, introduced the 'Lucifer', which was, however, only a copy of Walker's.

November 21, 1777.—The patent granted to Robert Stodart on Nov. 21, 1777, for "a new sort of instrument or grand forte-piano with an octave swell, and to produce various tones together or separate, which instrument will be more durable and produce finer and more variable tones than any yet made" supplies the first instance of the use of the term 'grand piano'.

November 21, 1833.—A needle-pointing machine which cuts off a length of wire sufficient for two needles, sharpens both ends, punches the eyes, and severs the wire into the two completed needles, was patented by Daniel Ledsam and William Jones on Nov. 21, 1833. Probably the machine never came into use. Apparatus of the kind was first used in Germany; its adoption in England came much later.

November 21, 1839.—The first superheater for locomotives—consisting of a chamber in the upper part of the smoke box heated by the furnace gases on their way to the chimney—was patented by Robert and William Hawthorn on Nov. 21, 1839, and was fitted to an engine supplied to the Newcastle and North Shields Railway in 1840. The locomotive superheater did not, however, come into general use until the introduction of the Schmidt fire-tube construction at the beginning of the present century.

Societies and Academies.

LONDON.

Royal Society, Nov. 7.—H. E. Roaf: The absorption of light by the coloured globules in the retina of the domestic hen. The transmission of light by the coloured globules of the retina of the hen has been photographed by means of a microspectroscope and the wave-length limits of the absorption measured.—R. G. Tomkins: Studies of the growth of moulds (1). When moulds are germinating on a substratum of soil, in equilibrium with the atmosphere, at any given temperature rate of germination decreases as humidity decreases. The rate is greatest at an optimum temperature, varying for different fungi. If the soil contains nutrients, rate of growth and range of humidity and temperature are increased. The growth of a 'colony' is similarly affected by conditions.—R. H. Stoughton: The morphology and cytology of *Bacterium malvacearum* E.F.S. Using a special technique, depending on staining the organisms without drying or heating, certain structures are demonstrable in the cells. One of these is a deeply staining centrally placed body of the nature of a nucleus. Two kinds of new growth-forms have been demonstrated. The first are small deeply staining granules, apparently identical with the 'gonidia' of other writers. The second are spherical coccus-like cells, produced by a process of budding from rods, in old cultures of the organism. The 'nucleation' of this coccus has been observed.—E. C. Smith: On the coagulation of muscle plasma. The preparation and properties of a liquid expressate of muscle, representing as nearly as possible the living plasma, are described. Gelation occurs only when a trace of a neutral salt is added to the finely divided muscle in the frozen state. Gelation of plasma and hardening of muscle in rigor mortis are the same phenomenon. Changes in hydrogen ion concentration are irrelevant to gelation.—S. L. Hora: Ecology, bionomics, and evolution of the torrential fauna, with special reference to the organs of attachment. Shows, from purely ecological and biological points of view, how animals become adapted to their surroundings; causes of variations and mode of their transmission are not considered. Attention is directed to the close correlation existing between 'factors' in environment and 'characters' of population, and specially to the divergence and convergence of characters, so far as influencing the course of organic evolution. Environment is the supreme master of most changes in animal organisation; organic evolution is an index of the varied conditions under which life exists.—R. N. Mukerji: Effect of X-radiation on the spermatogenesis of *Lepisma domestica*. The Golgi bodies in the spermatocytes approach the nucleus, swell up and fuse. Precocious formation of the acrosomic granule sometimes occurs. The mitochondria and their derivative, the *nebenkerne*, undergo various alterations in the spermatids. The vacuolar system remains unaffected, and the nurse-cells show no definite changes.—J. B. Gatenby, R. N. Mukerji, and Sylvia Wigoder: The effect of X-radiation on the spermatogenesis of *Abraxas grossulariata*. After 6 hours the mitochondria in many cells swell up. By 16 hours the Golgi elements approach the spermatocyte nuclei, forming caps, which later become detached as large spheres lying in the cytoplasm. These spheres contain an acrosome bead, and are absorbed by 20 hours. No very abnormal mitoses are found until after 37 hours.

Society of Public Analysts, Nov. 6.—E. R. Bolton and K. A. Williams: The grouping of fatty oils with special reference to olive oil. If the unsaponifiable matter be separated as described, and its iodine value determined, the oils are divided into four groups: Group 1—iodine value 64 to 70—contains the animal fats and a few vegetable fats (the coconut family); Group 2—iodine value 90 to 96—contains fish and marine animal oils and cocoa-butter; Group 3—iodine value 117 to 124—contains the vegetable oils and fats; Group 4—iodine value 197 to 206—contains olive oil only.—Cuthbert Dukes: The heat resistance curve. A new bacteriological test for pasteurised food. Pasteurised food differs from unpasteurised in that subsequent heating causes a large reduction in the number of bacteria only when temperatures higher than the pasteurising temperature are reached, whereas in unpasteurised food the bacteria are reduced progressively and uninterruptedly as the temperature is raised.—W. R. Mummery and F. Bishop: A new borax solubility test for lactic acid or natural sour casein. A new method has been based on the fact that 12·5 gm. of borax in water are required to dissolve 100 gm. of good commercial casein to obtain a solution which, when diluted, had a constant *p*H value. This value is termed the 'solubility index', and affords a means of classifying caseins.

PARIS.

Academy of Sciences, Sept. 30.—George D. Birkhoff: The demonstration of an elementary theorem on integral functions.—M. Kourensky: The integrals of the equations of motion of a solid body in a liquid.—G. P. Arcay: Contribution to the experimental study of the deformation of the flat spiral. The method used was a kinematographic study by condensed sparks.—Corradino Mineo: The orientation of the terrestrial equatorial ellipse.—Erik A. Holm: The state known as the *Sama-Zustand*.—J. Calvet: The attack of aluminium by ammoniacal solutions. Three samples of aluminium of varying purity (impurities 0·04 per cent, 0·29 per cent, and 0·82 per cent) were used in these experiments. In alkaline solutions, very pure aluminium is not more resistant to attack than ordinary aluminium.—R. Brunschwig and L. Jacqué: A method of testing motor benzene. Controlled oxidation by air at 100° C. is proposed: it is shown that the method gives a fair idea of the amount of resins which would be formed after storing for nine months.—Const. A. Kténas: The alkaline character of the volcanic lavas of Antiparos (Cyclades).—V. Pérébaskine: Geological observations in the loop of the Niger.—R. Dostal: Reproduction in *Caulerpa*. In a previous paper the author has proved the existence of zoospores of *Caulerpa prolifera*, and suggested that this might be an alternative method of reproduction. Further researches to elucidate this question have given negative results and no reproduction from the spores could be proved.—Mlle. L. Rémy: The etiology and therapeutics of plant tumours of a malignant type.—Gard: The plant disease *pourridié* and calcium carbonate. This disease may be due to *Armillariella mellea* (walnut, vine, plum), *Rosellinia necatrix* (vine) or *Pilacre pallida* (vine); it is always associated with a soil deficient in calcium carbonate.—P. Vignon: The wing of the Hymenoptera.—Brocq-Rousseu, Mme. Z. Gruzewska, and G. Roussel: The amylase of horse serum and the variations of its activity as a function of successive bleedings. The results are summarised in four curves.

Oct. 7.—G. Bigourdan: The measurement of the inclination of the axis of rotation of the meridian telescope, in determinations of time.—Georges Perrier: The international ellipsoid of reference. Its tables.

The ellipsoid of revolution calculated by Hayford in 1909 has been adopted as the international ellipsoid, but its use necessitates the calculation and publication of accessory tables. An account is given of such tables calculated by Hasse, and, over a limited range, by Väisälä.—**Ch. Achard** and **A. Arcand**: The comparative study of the proteids in blood serum and in pathological serosities.—**E. Mathias**: Contribution to the study of fulminating matter. The surface tension.—Division of a globe into several others under the influence of a shock or of a rebound.—**V. Romanovsky**: Probabilities *a posteriori*.—**S. Finikoff**: Series of Laplace containing congruences of Wilczynski.—**Krawtchouk**: Characteristic numbers and fundamental functions.—**Henri Cartan**: The growth function attached to a meromorph function of two variables and its application to meromorph functions of one variable.—**Alex. Froda**: The general solution of algebraic equations.—**J. Le Roux**: The theoretical bases of the law of gravitation.—**Eligio Perucca**: A metallic resistance of 10^{10} to 10^{11} ohms. A film of gold on quartz fibre can be obtained by cathode projection in a vacuum, and the resistance can be adjusted between 10^{10} and 10^{12} ohms by stopping the deposition at the required point. After some days standing these films have the following properties: the conduction obeys Ohm's law, there is no trace of E.M.F. of polarisation, and the temperature coefficient is negligible. The possible applications of resistances thus prepared are discussed.—**Albert Levasseur**: Simple formulæ permitting in all cases the rapid calculation of ohmic resistances with alternating current. The formula gives figures which do not differ from Kelvin's table by more than 1·5 per cent as a maximum.—**E. Calvet**: The heat of hydrolysis of the amides: acetamide. A direct method with a microcalorimeter was employed instead of the usual indirect method based on the heats of combustion.—**A. Sanfourche**: The oxidisability of silicon as a function of its state of division. Reply to a criticism by Bedel. Fresh experiments in support of the influence of the state of division of the silicon on its oxidisability are given.—**Mme. N. Demassieux**: The action of alkaline oxalates on the halogen salts of lead in aqueous solution. The interaction of lead halides with solutions of sodium oxalate gives results closely resembling those previously obtained with lead halides and sodium carbonate.—**Mathieu**: The study by means of the X-rays of some halogen salts prepared by Mme. Demassieux.—**M. and Mme. Clément Duval**: The study of the cobaltipentammines and researches on a new case of isomerism.—**P. Cordier**: The dialkyloxysuccinic anhydrides.—**J. Errard**: The action of mixed organo-magnesium derivatives on propargyl acetal.—**M. Bridel** and **Mlle. C. Bourdouil**: The transformations of the glucides in the course of the ripening of bananas.—**Marc André**: An adult form of *Thrombicula autumnalis*.

Leningrad.

Academy of Sciences (*Comptes rendus*, No. 15).—**N. Loewinson-Lessing** and **O. Vorobjeva**: Contribution to our knowledge of orbicular structures in igneous rocks. Microstructure of several nuclei of spheroids in orbicular igneous rocks is described and it is concluded that the spheroids cannot be regarded as concretions; they are fragments of the same rock partly altered by resorption but still retaining their original structure in the nucleus.—**D. Beliankin** and **K. Bezborodov**: Contact-metamorphic structures in technical processes. Phenomena of the type of contact metamorphosis in eruptive rocks are repeated to some extent in certain technical processes; examples of such processes in the glass industry are described.—**P. Schmidt**: The Pacific species of the genera *Microstomus* and *Glyptocephalus* Gottsche (Pisces, Pleuronectidæ). A revision of the genera named; in each of them the author recognises only two species.—**V. I. Vernadskij**: The capillary water in rocks and minerals. Every natural mineral contains a certain amount of capillary water which may be either fresh, or represent a solution of various salts. The presence of water must be taken into account in all analyses of minerals, otherwise serious mistakes are unavoidable.

Sydney.

Linnean Society of New South Wales, Sept. 25.—**J. R. Malloch**: Notes on Australian Diptera (2). Deals with four Australian species of *Ommatius*, of which three are described as new.—**G. M. Goldfinch**: Revision of Australian Geometridæ (Lepidoptera). A revision of the Australian species of the two archaic groups of the family Geometridæ, s. str., in which forty-seven species are recorded. Two new genera are proposed, ten new species described, and several points of confusion settled.—**G. D. Osborne**: Some aspects of the structural geology of the Carboniferous rocks in the Hunter River district between Raymond Terrace and Scone. The Hunter Overthrust possesses some unique features, and its age is regarded as being quite different from that of the normal faults and of the folding. The diatrophism manifested in the presence of the latter developed mostly in late Palæozoic time, although the probability of some orogeny, apart from the Hunter Overthrust movement, having occurred in post-Triassic time is recognised. The nature of the folding and its analysis are given.

Vienna.

Academy of Sciences, July 4.—**E. Beutel** and **A. Kutzlnigg**: The action of iron chloride on zinc.—**L. Moser** and **W. Reif**: The determination and separation of rare metals from other metals (16). The separation of thallium from ter- and quadri-valent metals. There are now several methods, but in all cases thallium is determined as chromate. One method depends on the precipitation of thallium chromate in the presence of ammonia and sulphosalicylic acid, another method is by the hydrolysis of the trivalent metals by ammonium nitrite and methyl alcohol.—**L. Moser** and **W. Blaustein**: The determination and separation of rare metals from other metals (17). The precipitation of tungsten with tannin and antipyrin, its separation from the ter- and bi-valent metals, from tin and from silicic acid. Colloidal metal hydroxides form with tannic acid difficultly soluble adsorption compounds. The excess of tannic acid is precipitated with antipyrin. From stannic acid the best separation is by hydrogen sulphide from a complex tartrate solution. A separation of colloidal silica from tungstic acid depends on velocity of precipitation.—**E. Steinach** and **H. Kun**: The promotion of central activities by a stimulant from the central organ. A new field of work has arisen from earlier experiments on sexual hormones. Frogs were decapitated and then injected with a brain extract. For testing irritability a series of weak acetic acid solutions (less than 1 per cent) were employed to determine the threshold or weakest solution at which a reflex whisk movement would be made. The injected animals showed a much lower threshold than the controls. The water soluble brain extract has a specific effect not shared by the extracts of other organs. The extract loses its activity at boiling-point. Brains of frog, rat, dog were tried, chiefly cattle brains,

in one case human from a post-mortem. All were active; the stimulant is not species-specific. Experiments were also made on green tree-frogs which were tested by the number of flies they could snap up in ten seconds.—A. Klemenc and E. Hayek: The dissociation constant of nitrous acid.—A. Klemenc and E. Spitzer: The solubility of nitric oxide in carbon tetrachloride, benzole, and nitrobenzole.—A. Müller and H. Wachs: Synthesis of α-ethyl-pyrrolidine.—E. Mosettig and L. Jovanovic: The action of diazomethane on aromatic ketones.—K. Fuchs and F. Breuer: Alkali organic compounds containing sulphur.—P. Gross: The theory of the action of salts.—E. Späth and O. Schmidt: The constitution of pseudobaptisin.—R. Seka, G. Schreckental and P. S. Heilperin: The synthesis of pyridanthrone and anthracumarine.—E. Zerner and H. Goldhammer: Diphenyloxy-acetaldehyde.—C. Mayr and G. Burger: The potentiometric titration of mercurous ion with ammonium oxalate and its application in the determination of chromate.—L. Schmid and M. K. Zacherl: Conductivity measurements in liquid ammonia.—F. Feigl and A. Bondi: The reactivity of iodine in organic solvents.—G. Sachs and K. Fürst: Mercury nitrobenzols.—F. Wessely and K. Sturm: The constitution of phlorrhizine.—A. Franke: Ring contraction on the formation of inner ethers from glycols.—R. Dworzak and W. Prodinger: Products of bromation of iso-butyr-aldehyde.—F. Hecht and W. Reich-Rohrwig: The determination of uranium and thorium by means of 8-oxyquinolin.—F. Sigmund: The catalytic action of platinum sponge and platinum oxide in hydration.—F. Faltis and F. Kloiber: Derivatives of hemipinic acid.—E. Philippi: The linear pentacene series (13). Nomenclature and structure problems.—F. Hernler and K. Schnürch: The linear pentacene series (14). Pentacene-quinone-6, 13.—F. Hernler and O. Sommer: The linear pentacene series (15). The 6, 13-dioxy-pentacene-diquinone-5, 7, 12, 14.—F. Hernler and T. Bruns: The linear pentacene series (16). Pentacene-diquinone-5, 7, 12, 14-disulpho acid and tetraoxy-pentacene-diquinone-5, 7, 12, 14.—G. Machek: The linear pentacene series (17). Dinitro-, diamino- and dioxy-derivatives of pentacene diquinone-5, 7, 12, 14.—F. Hernler: Oxidation products of the three isomeric tolyl-1-dimethyl-3, 5-triazole-1, 2, 4.—K. Brunner and H. Moser: A remarkable formation of 1-phenyl-5-methyl-3-pyrazole.—H. Suida and H. Titsch: Acetyl-wood, the agglutination of incrustations and a new way of separating the constituents of wood.—W. J. Müller and K. Konopicky: The motoelectric effect.—H. Meyer and K. Bernhauer: The alkylisation of aromatic compounds.—A. Skita and F. Keil: The formation of tertiary amines in the reduction of nitriles and of carbonyl compounds in basic solution.—M. Dunkel and H. Mark: Anomalies in the region of dilute absorption.—E. Moles and T. Batuecas: The mass of the normal litre of ammonia.—A. Stock and W. Zimmermann: Vapour pressures of mercury and of some mercury compounds at low temperatures.—T. Wagner-Jauregg: Racemisation of halogen substituted esters.—J. Billiter: Methods for determining absolute potentials.—F. Schembor: Results of radiation measurements on the Stolz Alp between Oct. 1, 1927, and Nov. 1, 1928.—T. Pinter: *Tetrarhynchus erinaceus*.—L. Abolins: The regeneration of legs mutilated at the fibular edge in *Triton cristatus*. The excised fibula was in 50 per cent of all cases replaced by a long bone.—I. Sciacchitano, P. Weiss, and H. Przibram: The regeneration of legs mutilated at the tibial edge or medially in *Triton cristatus* and the heteromorphosis of the long bones after excision of the fibular edge. The excised tibia was not regenerated within two months.—H. Przibram: Growth measurements in *Sphodromantis bioculata* (4). Increase in size and number of facets. The number of eye-facets in the praying mantis doubles after ten changes of skin.—E. Dittler: The question of the stage of oxidation of titanium in the silicates.—O. Halpern: Note on the phase theory in thermionics.—E. Haschek: Plane grating spectroscopes with wave-length drums. A simple mechanical arrangement determines the sine of the angle of deviation and therewith the wave-length.—G. Jäger: The velocity law of gas molecules.—H. Schober: The colouring by radium radiation of rock-salt crystals stretched under water and strained beyond normal tensile strength. It was known that rock-salt crystals are much stronger under water than in air, and it was suspected that coloration was due to small ultra-microscopic irregularities in the crystal lattice. An alteration of the interior of the crystal took place, though not so clearly as in the bending experiments.—H. Mache: The diffusion and transition of gases in liquids (1). Solution and growth of air-bubbles in water. A small air-bubble was introduced into a sphere filled with water already containing dissolved air. By means of raising or lowering a tube containing mercury the pressure on the water was changed and the size of the air-bubble observed.—E. Heinricher: Researches on the descendants of *Primula kewensis* and their diversity of form. Successful attempts to fix certain forms were made by means of homostylous and self-fertilised plants.—T. Ohnesorge: Report on geological investigations round Wald and Krimml in Upper Pinzgau.—L. Hofmann: The connexion of the problem of projection with the relations between incident straight lines and planes in R_4. With an application to photograms.—O. Sickenberg: A hot spring in the lower Pliocene in the Vienna thermal line near Leobersdorf in Lower Austria. A peculiar conglomerate containing fossil shells and also calcite and silica seems to have been formed under the influence of the spring.—A. Skrabal and A. Zahorka: The water saponification of ethyl acetate.—R. Müller: The electromotive behaviour of the metals of the rare earths and their amalgams. (1) Experiments with lanthanum.—R. Müller and H. J. Schmidt: (2) Experiments with cerium.—A. Rollett: Experiments on brein from Manila elemi resin.—F. Hölzl, T. Meier-Mohar, and F. Viditz: The alkylisation of hexacyano-cobaltic acid.—A. Pongratz and F. Griengl: The heats of combustion of perylene and some of its derivatives.—J. Lindner, O. Brugger, A. Jenker, and L. Tschemernigg: Researches on tolyl-halogen-phosphine.—J. Lindner and M. Strecker: Researches on naphthyl-halogen-phosphine and -phosphinic acid.—A. Zinke and H. Kolmayr: Researches on perylenes and their derivatives (26).—A. Musil: The saponification of methyl acetate with alkali carbonates.—G. F. Hüttig: The addition compounds of the lithium halogenides with methyl alcohol and ethyl alcohol.—G. Jantsch, H. Alber, and H. Grubitsch: The halogenids of europium.—F. Emich: The observation of flaws (*Schlieren*) in chemical work.—R. Kremann, B. Kurth, E. I. Schwarz, and W. Pivetz: Electrolysis of molten ternary alloys.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (4). The Raman spectrum of organic substances (benzol derivatives).—K. Lohberger: Some new fish forms from Lake Victoria.—H. Reschovsky: Rational curves.—G. Nöbeling: The continuous representation of the circle on regular curves.—H. Hornick: Connexion of the second degree.—W. L. Ayres: (1) Closed curves in Peano's spaces.—(2) The density of dissection points and end points.—K. Przibram: A scheme of the colouring effects in rock-salt.

Official Publications Received.

BRITISH.

Ministry of Agriculture and Fisheries. Report of the Departmental Committee on the Reconstruction of the Royal Veterinary College. Pp. 26. (London: H.M. Stationery Office.) 1s. 3d. net.

British Cast Iron Research Association. Eighth Annual Report for the Year ending June 30th, 1929. Pp. 31. (Birmingham.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part 2. Pp. v+128+3 plates. (London: H.M. Stationery Office.) 3s. net.

Journal of the Chemical Society: containing Papers communicated to the Society. October. Pp. iv+2173-2425+x. (London.)

Proceedings of the Royal Society. Series A, Vol. 125, No. A798, October 1. Pp. 393-578. 6s. Series A, Vol. 125, No. A799, November 1. Pp. 579-734+vi. 5s. (London: Harrison and Sons, Ltd.)

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 4, No. 12: A Spectroscopic Investigation of Beta Cephei. By Ralph N. Van Arnam. Pp. 171-178. Vol. 4, No. 13: Two Highly Eccentric Orbits. By W. E. Harper. Pp. 179-187. Vol. 4, No. 14: Line Intensities in Nebular Spectra. By H. H. Plaskett. Pp. 187-207. (Victoria, B.C.)

Ninth Annual Report of the Scientific and Industrial Research Council of Alberta, 1928. (Report No. 24.) Pp. 53. (Edmonton, Alba.: W. D. McLean.)

Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Septième Session, Saranac Inn, N.Y., Septembre 1928. Recueil des Travaux et Compte Rendu des Séances. Pp. 1268. (Teddington: National Physical Laboratory.) 5 dollars.

Records of the Geological Survey of India. Vol. 62, Part 3. Pp. 293-389. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 2, July. Pp. 146. (Singapore.) 60 cents; 1s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1260 (Ae. 409): Flight Tests on an Atlas fitted with Automatic Slots connected with the Ailerons and some Data relevant to the Design of Auto-Slots for R.A.F.28 Section Wing. By E. T. Jones. (T. 2777.) Pp. 8+6 plates. (London: H.M. Stationery Office.) 6d. net.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 4, No. 4, October. Pp. 307-397. (Cambridge: At the University Press.) 12s. 6d. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 60, Part 2, June. Pp. iv+205-378+plates 18-32. (Wellington, N.Z.)

Journal of the Society of Glass Technology. Vol. 13, No. 51, September. Pp. viii+71-296+xxx. (Sheffield.) 10s. 6d.

The Journal of the Board of Greenkeeping Research. Maintained by the British Golf Unions' Joint Advisory Committee for the Scientific Investigation of Greenkeeping Problems. Vol. 1, No. 1, November. Pp. 48+4 plates. (Bingley: St. Ives Research Station). 2s. 6d.

British Honduras. Report of the Forest Trust, 1928. Pp. 17. (Belize.)

FOREIGN.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 4, October. R.P. No. 108: Compressive Strength of Clay Brick Walls, by A. H. Stang, D. E. Parsons and J. W. McBurney; R.P. No. 109: Determination of Manganese in Steel and Iron by the Persulphate-Arsenite Method, by H. A. Bright and C. P. Larrabee; R.P. No. 110: Determination of Fluorine and of Silica in Glasses and Enamels containing Fluorine, by J. I. Hoffman and G. E. F. Lundell; R.P. No. 111: The Heat of Formation of Sulphur Dioxide, by J. R. Eckman and Frederick D. Rossini. Pp. 507-618+20 plates. (Washington, D.C.: Government Printing Office.) 40 cents.

Bulletin of the Vanderbilt Oceanographic Museum. Vol. 1, Art. 1: Scientific Results of the Yacht *Ara* Expedition during the Years 1926 to 1928, while in Command of William K. Vanderbilt. Fishes. By N. A. Borodin. Pp. 37+5 plates. (Huntington, L.I.)

U.S. Department of Agriculture. Technical Bulletin No. 130: The Chestnut Curculios. By Fred E. Brooks and Richard T. Cotton. Pp. 24+6 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Smithsonian Miscellaneous Collections. Vol. 81, No. 15: Arthropods as Intermediate Hosts of Helminths. By Maurice C. Hall. (Publication 3024.) Pp. 77. (Washington, D.C.: Smithsonian Institution.)

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 475: The Production and Marketing of New York Market Peas. By Dilworth Walker. Pp. 137. Bulletin 476: The Utilization of Marginal Lands. By William Allen. Pp. 109. Bulletin 477: Composition and Body of Butter. By E. S. Guthrie. Pp. 34. Bulletin 480: Premature Seeding of Celery. By H. C. Thompson. Pp. 50. Bulletin 482: Soil and Field-Crop Management for Yates County, New York. By H. O. Buckman, H. P. Cooper and F. B. Howe. Pp. 83. Bulletin 484: A Comparison of the Cost of Maintenance of Large and of Small Country Boards in the United States; a Study in the Cost of Government. By M. Slade Kendrick. Pp. 41. Bulletin 486: An Economic Study of the Collection of Milk at Country Plants in New York. By Leland Spencer. Pp. 47. Memoir 124: The Rhizoctonia Damping-Off of Conifers, and its Control by Chemical Treatment of the Soil. By James Stewart Wiant. Pp. 64. (Ithaca, N.Y.)

Reports of the Conferences on Cycles. Pp. 83. (Washington, D.C.: Carnegie Institution.) Free.

Carnegie Institution of Washington. Publication No. 390: Second Bibliography and Catalogue of the Fossil Vertebrata of North America. By Oliver Perry Hay. Vol. 1. Pp. viii+916. 7.50 dollars. Publication No. 395: Race Crossing in Jamaica. By C. B. Davenport and Morris Steggerda; in collaboration with F. G. Benedict, Lawrence H. Snyder, Arnold Gesell, Inez Dunkelberger Steggerda, and many Residents of the Colony of Jamaica. Pp. ix+516+29 plates. 7 dollars. (Washington: D.C.: Carnegie Institution.)

Methods and Problems of Medical Education. (Fourteenth Series.) Pp. v+207. (New York City: The Rockefeller Foundation.)

University of Illinois Engineering Experiment Station. Bulletin No. 195: The Plaster-Model Method of Determining Stresses Applied to Curved Beams. By Prof. Fred B. Seely and Prof. Richard V. James. Pp. 33. (Urbana, Ill.) 20 cents.

CATALOGUES.

A Catalogue of Autograph Letters, Manuscripts and Documents. (New Series, No. 4.) Pp. 96. (London: Francis Edwards, Ltd.)

West Indies: a Catalogue of Books, Maps and Engravings, including Sections on Guiana, Slave Trade and Buccaneers and Pirates. (No. 519.) Pp. 60. (London: Francis Edwards, Ltd.)

S.U.P. 36 for the Treatment of Colds, Influenza, Broncho-Pneumonia, Pneumonia, Asthma and other Inflammatory, or Septic, Conditions. Pp. 16. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 15.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. G. L. K. Pringle: A Survey of 2000 Cases of Rheumatic Disease.

BRITISH INSTITUTE OF RADIOLOGY (Informal Meeting), at 5.—Discussion on Radiology in Obstetrics.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F. Hodgkinson: Journal bearing Practice.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. B. C. Laws: The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage.

INSTITUTE OF FUEL (at University College, Nottingham), at 7.—Dr. J. W. Whitaker: Coals and their Impurities.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—E. W. Selby: Compound Locomotives.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.15.—S. Dixon: Some Recent Food Investigations.

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—G. E. Sharp: Selling Time Switches.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. T. Griffiths: Nickel and its Uses in Engineering.

ROYAL AERONAUTICAL SOCIETY (at St. Ermin's Hotel), at 7.30.—Discussion: That this Meeting is of the opinion the Present Rules for the Schneider Trophy Race and the High-Speed Record are not consistent with the Proper Development of High-Speed Aircraft.

ROYAL SANITARY INSTITUTE (at Town Hall, Carlisle), at 7.30.—P. Dalton and others: Discussion on Town Planning of Built-Up Areas.—C. J. H. Stock and others: Discussion on Some Dangers and Difficulties of Small Water Supplies.—R. Simpson and others: Discussion on The Veterinarian in Relation to the Milk Supply.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Special General Meeting.

TEXTILE INSTITUTE (Lancashire Section) (at Rochdale Technical School), at 7.30.—J. Ryan: The Problems of the Cotton Industry with special reference to the Spinners' Difficulties.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.—R. J. Bartlett: Some Effects of Low-Frequency Vibration.—S. Wyatt: Factors in Unproductive Time.—Dr. A. Macrae: Some Problems of Vocational Guidance.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Dr. J. E. Hughes: A Case of Hydatidiform Mole with Multiple Small Syncytial Infarction of the Lungs.—Dr. Kathleen Vaughan: Maternal Mortality and its Relation to the Shape of the Female Pelvis.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. Jessie E. Sheret: Massive Collapse of the Lungs.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Nottingham Section).—J. A. Reavell: The Scientific Heating of Liquids and Gases.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. F. A. Mason: Peter Griess.

SATURDAY, NOVEMBER 16.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—C. Fox: Mental Energy.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—Conference: Is there a Changing Trend in the Textile Industry?

PHYSIOLOGICAL SOCIETY (at Cardiff).

MONDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (jointly with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers), at 7.—A. G. Brown: Artificial Lighting of Factories and Public Buildings.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Dr. N. W. McLachlan: The Theory and Practice of Modern Loud Speakers.

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—S. Kershaw: Uniform Worsted Yarn Processing.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. E. Munby: The Design of Science Buildings.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. G. Richardson: Wind Instruments from Musical and Scientific Aspects (Cantor Lectures) (I.).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—C. Wells: The Colour of Ruwenzori.

ROYAL AERONAUTICAL SOCIETY (Oxford Branch) (at Oxford).—Squadron Leader Orlebar: The Schneider Trophy Race and the Air Speed Record.

TUESDAY, NOVEMBER 19.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Prof. J. H. Jones: The Present Position of the British Coal Trade.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—E. F. Pollock: Exhibition of Lantern-slides of Australian Fauna.—Dr. Ida C. Mann: Demonstration of Iris Pattern in Vertebrates.—H. B. Cott: (*a*) The Zoological Society's Expedition to the Zambesi, 1927. No. 2. Observations on the Natural History of the Land-Crab, *Sesarma meinerti*, from Beira, with Special Reference to the Theory of Warning Colours; (*b*) No. 3. Observations on the Natural History of the Racing Crab, *Ocypoda ceratophthalma*, from Beira.—Dr. Anna B. Hastings: Cheilostomatous Polyzoa from the Vicinity of the Panama Canal, collected by Dr. Cyril Crossland on the Cruise of the S.Y. *St. George*.—H. C. Abraham: The Male of the Spider *Liphistius malayanus* Abraham, with Further Notes on the Female and its Habits.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. E. G. Coker: Some Experimental Methods and Apparatus for Determining the Stresses in Bridges and Framed Structures.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—O. Stott: The Fan Standards Committee's Report.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. C. J. P. Cave: The Telephotography of Architectural Details with the Aid of the Spotlight.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. J. H. Andrew: Some lesser known Facts concerning Alloy Steels.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. W. J. Sollas: The Sagittal Section of the Human Skull.

WEDNESDAY, NOVEMBER 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.10.—M. G. Bennett: The Physical Conditions Controlling Visibility through the Atmosphere.—Dr. L. F. Richardson: The Reflectivity of Woodland, Fields, and Suburbs between London and St. Albans.—*To be taken as read*:—Thora C. Marwick: The Electric Charge on Rain.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. D. Williams: The Geology of the Country between Nant Peris and Nant Ffrancon (Snowdonia).—Beeby Thompson: The Upper Estuarine Series of Northamptonshire and North Oxfordshire.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at British Sea Anglers' Society, 4 Fetter Lane), at 5.30.—Rhys Jenkins: D'Acres, "The Art of Water Drawing", 1659.

OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—R. Borlase Matthews: Standard Intermediate Voltages for Rural Electrification.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30—G. C. Bunn: Address.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—H. Mawson: Multiple Refrigerating Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—A. Tustin: Organised Scientific Research and Engineering Progress.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—J. Innes: The Manufacture of Artificial Silk.

ROYAL SOCIETY OF ARTS, at 8.—P. M. Horder: Urban and Rural Amenities.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. P. de Beauchamp: *Dicranophorus hudsoni* (Glascott).—Dr. J. A. Hewitt: Sarcocystis in Human Heart Muscle.—T. E. Wallis: The Projectograph. An Optical Instrument for the Projection of Images of Microscopical Objects.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—Prof. J. P. Hill: The Developmental History of the Primates (Croonian Lecture).

LINNEAN SOCIETY OF LONDON, at 5.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with Institute of Fuel), at 6.—Discussion on Low-Temperature Carbonisation of Fuel, with Special Reference to its Combination with the Production of Electricity. Introductory Papers by E. H. Smythe and E. G. Weeks (English Practice); S. McEwen (American Practice); Prof. P. Rosin (German Practice).

ROYAL PHOTOGRAPHIC SOCIETY (Kinematograph Group—Informal Meeting), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—Dr. J. W. T. Walsh: Illuminating Engineering.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Aeronautical Society) (at Royal Society of Arts), at 7.45.—L. W. Johnson: The Inspection of Metals and their Alloys.

CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry: The Rotatory Dispersion of Organic Compounds. Part XVIII. The Validity of Drude's Equation.—G. M. Bennett, F. Heathcoat, and A. N. Mosses: The Influence of the Sulphur Atom on the Reactivity of Adjacent Atoms or Groups. Part III. δ- and ε-Chlorosulphides.—G. M. Bennett and W. B. Waddington: Studies in the Penthian Series. Part II. Penthian-4-one. Part III. Stereoisomeric Derivatives of some Penthianols.—F. G. Angell, H. D. K. Drew, and W. Wardlaw: A New Interpretation of the Isomerism amongst Co-ordination Compounds of Platinum.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting at London School of Hygiene and Tropical Medicine), at 8.15.—Demonstrations by A. Balfour, W. B. Alcock, C. A. Hoare, E. Hindle and A. C. Stevenson, Col. S. P. James, H. S. Leeson, M. E. MacGregor, J. F. Marshall and J. Staley, A. Robertson, J. W. Scharff, A. L. Sheather and A. C. Stevenson, H. M. Shelley, Miss E. Sikes, C. M. Wenyon, V. B. Wigglesworth, and Prof. Warrington Yorke.

ROYAL AERONAUTICAL SOCIETY (Bristol Branch) (at Bristol).—Mr. Fraser: Wing Flutter.

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Manchester).—R. Defries: Unburstable Balls.

FRIDAY, NOVEMBER 22.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—D. P. Dalzell: Heaviside's Operational Methods.—E. T. Hanson: The Dynamical Theory of Resonators.—E. C. Atkinson: Escapement Errors of Pendulum Clocks.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—H. W. Rowell: Commercial Synthetic Resin Products.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. S. Atkinson and others: The Utilisation of Low-Grade and Refuse Fuels, including Towns' Refuse.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. D. Bush: The Quick-Running Oil Engine applied to and used in Railway Service.

ROYAL SOCIETY OF MEDICINE (Epidemiology and Tropical Diseases Sections), at 8.—Discussion on Brucella Infections in Man and Animals. Openers: Dr. W. Dalrymple-Champneys (Epidemiology), Dr. J. T. Duncan (Tropical).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Aero Wheels and Tyres.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: The Marvels of India's Canals.

MONDAY, NOVEMBER 18.

UNIVERSITY COLLEGE, at 2.—Dr. O. L. Brady: Alchemy and the Alchemists.

LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers: The Circumnavigation of Africa, Attempts to cross the Atlantic.

KING'S COLLEGE, at 5.30.—Prof. H. Zichendraht: Scientific Radio Research in Switzerland. (Succeeding Lectures on Nov. 20, 22, 25, 27, and 29.)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—R. H. Grubb: The Pruning of Fruit Trees.

TUESDAY, NOVEMBER 19.

BRITISH SCIENCE GUILD (at Goldsmiths' Hall, E.C.2), at 4.30.—Sir Walter Morley Fletcher: Medical Research: The Tree and the Fruit. (Norman Lockyer Lecture.)

UNIVERSITY OF LEEDS, at 8.—Prof. B. A. McSwiney: Health.

WEDNESDAY, NOVEMBER 20.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. M. Donaldson: The Early Diagnosis and Treatment of Malignant Disease.

KING'S COLLEGE, at 5.30.—Prof. W. T. Gordon: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Geology and Geography; The Estonian Minister in London: Modern Estonian Literature.

ROYAL SCHOOL OF MINES, at 6.—Sir Harold Carpenter: Single Crystals of Metals and Alloys: Their Production and Properties (Armourers and Brasiers' Company Lectures) (I.). (Succeeding Lectures on Nov. 27 and Dec. 4.)

FRIDAY, NOVEMBER 22.

KING'S COLLEGE (at 40 Torrington Square, W.C.1), at 5.30.—Dr. O. Odlozilik: Outlines of Czechoslovak History (I.): The Geography of Czechoslovakia.

SURVEYORS' INSTITUTION, at 5.30.—Dr. A. W. Hill: Kew and its Relation to Botanical Enterprise in the Empire (Institution of Professional Civil Servants' Lecture).

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Village Life in the Middle Ages.

CONFERENCES.

FRIDAY, NOVEMBER 15.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30.—Conference on the Growth of Winter Food for Livestock. In Chair, Lord Clinton.

J. G. Stewart, of the Ministry of Agriculture.
Harald Faber: The Danish Solution of the Problem.
Dr. H. E. Annett: The New Zealand Solution of the Problem.
W. B. Mercer and W. A. C. Carr: Winter Food for Dairy and Feeding Cattle.
Capt. R. Stallard: Winter Food for Dairy Cows.
T. C. Ward: Winter Food for Cattle.

NOVEMBER 18 TO 23.

PUBLIC WORKS, ROADS AND TRANSPORT CONGRESS AND EXHIBITION (at Royal Agricultural Hall).

NOVEMBER 21.

BRITISH WATERWORKS ASSOCIATION (Public Works Congress at Agricultural Hall).

G. L. Pepler: Water Supply as a Factor in Town and Regional Planning.
Dr. J. B. Firth: The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution.
Dr. W. Rushton: The Purity of Drinking Waters from a Biological Aspect.

NATURE

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No. 3134, Vol. 124]

Airships and Arctic Meteorology.

In recent years great advances have been made in our knowledge of the atmosphere. The increase in the number of observatories and the transmission of meteorological data from ships at sea have made material contributions to these advances. There are, however, still large areas of sea and land of which our knowledge is altogether inadequate for the advancement of science. Nowhere are there more significant gaps in the desirable network of stations than in polar regions. Observatories exist in Greenland, Jan Mayen, Spitsbergen, Novaya Zemlya, and Alaska, but throughout the length of Arctic Siberia and in most of Arctic Canada there are great areas from which no continuous series of observations are obtainable, and even the geographical features of a large part of the Arctic Ocean are unknown. The most northerly observatory is the Norwegian station at King's Bay, Spitsbergen. North of latitude 80°, there is not a single observatory, and even scattered data from the inner or ice-bound Arctic regions are very few and incomplete. In a recent lecture to the Royal Geographical Society, Dr. G. C. Simpson, the director of the Meteorological Office, said that little further advance in polar meteorology can be made by spasmodic meteorological observations. The short series of data brought back by exploring expeditions engaged primarily in other branches of work are not of great value. Permanent observatories alone can supply the want, and if these are provided with wireless, they can not only extend the area of the synoptic charts used in forecasting, but also reduce the area of the unknown for other general purposes of the science.

Within the last three years an International Society for the Exploration of the Arctic Regions by means of Aircraft has been established, with its headquarters in Berlin and with Fridtjof Nansen as president. National groups of members of the Society are in process of formation in many countries. One of the chief aims of the Society is the foundation of meteorological and magnetic observatories in high latitudes in Arctic regions. 'Aeroarctic', to give the society its shorter title, has also other aims, but those relating to meteorology and magnetism are at present in the forefront. The older means of transport, ship and sledge, have so far only allowed difficult and spasmodic advances into the ice-bound areas of the Arctic basin, and the uncertainty of these means of transport, dependent as they are on the variations in the ice-

cover from year to year, are prejudicial to the maintenance of permanent stations in high latitudes. The Society believes that the difficulties and uncertainties of Arctic transport can be overcome only by aircraft. The aeroplane is considered to be less useful than the airship. High speed is of less importance than carrying capacity and power to land without extensive ground preparations.

The programme that the Society has in hand is ambitious ; and it will not fail to evoke criticism. The presidency of Dr. F. Nansen and the support of many eminent meteorologists and polar experts throughout Europe and America is, however, a guarantee that the plans have been carefully considered. It must never be forgotten that it was Dr. Nansen who, nearly forty years ago, dared to defy the accepted canons of polar travel and the advice of nearly all polar experts in his daring and successful voyage in the *Fram*. Once again he is in the forefront in adopting new methods of locomotion.

The Society hopes to obtain the use for the spring of next year of the German airship *Graf Zeppelin*, and under the direction of Dr. Nansen a series of preliminary flights are projected. Difficulties have arisen on account of the crew having expressed unwillingness to take polar flights in the airship. The plan proposed is for three flights—the first is to be from Murmansk to Alaska via the north of Spitsbergen, Greenland, and the Beaufort Sea ; the second is to be a flight round the unknown Beaufort Sea ; and the third is to be from Alaska along the edge of the continental shelf north of Siberia via Nicholas or Northern Land to Murmansk. These are regarded as preliminary flights to settle definitely a few problems regarding the possible existence of unknown land, to investigate possible sites for permanent observatories, and to map the edge of the continental shelf. For the last purpose a form of sonic sounder dragged along the surface of the water will be used.

The Society hopes eventually to found observatories in Nicholas Land, Peary Land (Greenland), Grant Land (Ellesmere Island), and Banks Island, and to arrange for these to be relieved annually by airship. A further and more daring plan is to found observatories on the drifting pack-ice of the Arctic Sea, connected by wireless so that their daily position might be determined. It is calculated that the gross weight of such a station-building with food and fuel for two years would be about twenty-five tons. This, in addition to the weight of men and dogs, could be carried by an airship of sufficient size into any part of the Arctic regions. Lastly, the Society hopes to encourage the foundation of observatories on various Arctic lands accessible by sea, such as Franz Josef Land, the New Siberian Islands, the Siberian coast, and the Arctic Islands of Canada. It is hoped that the task of founding and maintaining these observatories would be undertaken by the States to which those territories belong.

The whole scheme is a daring experiment. Some people may even call it rash. But if it succeeds, even in part, it should result in considerable additions to knowledge. Amundsen and Nobile crossed the Arctic in an airship three years ago. Since then great improvements have been made in airship construction, and the *Graf Zeppelin* this year made a successful flight round the world, through many difficult weather conditions. It is true that last year the *Italia* airship came to grief in Arctic regions, but the *Italia* was a small ship, not suited to the task she undertook. There is no reason to be sceptical about the failure of aircraft and air navigation, when the advances made in the last few years are borne in mind. 'Aeroarctic' is looking well ahead in formulating its plans, and even if the full programme cannot be carried out for some years, the Society merits support in having devised the only scheme by which the scientific exploration of the inner Arctic regions seems to be at all possible.

In a few years there will occur the fiftieth anniversary of the year of international polar stations of 1882–83. Twelve States took part, each dispatching one or more expeditions to take a year's meteorological observations in high northern or southern latitudes. The jubilee year of that effort might suitably be celebrated by some similar international co-operation in high latitudes. On the other hand, it has been suggested that two permanent Antarctic observatories, in addition to the one already existing at the South Orkneys, and two additional ones in the Arctic, in Canada and Siberia respectively, might serve better the cause of meteorological and magnetic research. The adoption of either plan depends on the resources available and the foresight of the States concerned. It is impossible to promise definite practical results in weather forecasting from the foundation of such stations. All that can be said is that a more detailed knowledge of meteorology may entail results of practical value, and that without this knowledge such results cannot be forthcoming. 'Aeroarctic' makes no promise as to results. It is a purely scientific body, and in its efforts to establish polar observatories and further other lines of research it is moving in the right direction.

An Intimate View of Seventeenth Century Science.

The Correspondence of Spinoza. Translated and edited with Introduction and Annotations by Prof. A. Wolf. Pp. 502. (London: George Allen and Unwin, Ltd., 1928.) 15*s.* net.

THE thinkers of the seventeenth century took all knowledge for their provinces. The men of science were at the same time physicists, chemists, biologists, and geologists, might also be astronomers and architects; often, in addition, they showed deep interest in theological matters, although this interest was manifested in widely different ways, as witness the names of Boyle, Newton, and Leibniz. On the other hand, lawyers and philosophers took an active part in the scientific life which sprang into such activity in the second half of that century, ludicrous as might be the writings of a Matthew Hale on the vacuum, futile as might be the attacks of a Hobbes on the mathematical achievements of a Wallis. It was impossible for so bold and original a thinker as Spinoza not to take his part in the discussion of the new results that came pouring from the laboratories in a manner reminiscent of our own times, more especially as he was earning his living by grinding lenses. It is true that he made no original contribution to the scientific thought of the day, and likewise made no experimental discoveries. Nevertheless, from his letters we can form a lively picture of the days when the appearance of a "Certain excellent treatise on Sixty Observations with the Microscope" (Hooke's "Micrographia") was causing a sensation, and when Mr. Huygens was performing in London experiments confirming his hypothesis of impact; when Latin translations of the books of the very noble Mr. Boyle were eagerly awaited by continental writers unable to read English; and when "Hevelius of Dantzig and the Frenchman Auzout were disputing among themselves about the Observations which were made". The chief interest of the letters is undoubtedly for the philosophers who find therein discussed at length Spinoza's conception of God, but the man of science, as such, who has the faintest historic sense cannot but be entertained to find himself in a world where the transmutation of silver to gold witnessed by Helvetius was a matter of lively inquiry, and where the authority of Descartes was well-nigh absolute.

One of the chief figures in the correspondence of Spinoza is Henry Oldenburg, the secretary of the Royal Society, whom Hooke irascibly labelled as a "trafficker in intelligences". We find him communicating to Spinoza scraps of information about the work of Boyle (who, probably because Spinoza's religious views were so abhorrent to him, never wrote to him directly), in which Spinoza was keenly interested, and begging in return for "anything you may have learnt about the success of Huygens in the polishing of Telescopic Glasses", and in the same breath for political information: "Explain to me, if you can, what the Swede and the Brandenburger are driving at". However, as Prof. Wolf remarks in a note, Huygens' optical researches were carried out with such secrecy that Spinoza would not have learnt much about them even had he pushed his inquiries. He also seeks information on many metaphysical points, but, while praising Spinoza in the politest terms, seldom seems able to understand the replies. His mental parts stand out in these letters as clearly as his physical appearance does in the celebrated portrait at the Royal Society, and Hooke's contempt, if not altogether deserved, can be easily understood in view of the characters of the two men. A more celebrated figure in the correspondence is Leibniz, who in one letter sends Spinoza a "Note on Advanced Optics", saying that he will not easily find a better judge in this kind of study, which gives us a more favourable opinion of Spinoza's powers in this line than is furnished by the scraps of optical work found in Spinoza's own letters.

Great thinker as Spinoza was, his acuteness seems to have deserted him as soon as he meddled with experiment—a trait not unusual in philosophers. He describes one experiment, not particularly well contrived, which he made on the flow of liquids through a tube, and his conclusion from this was, in modern language, that liquids have no viscosity: "Therefore water running through a tube forty thousand feet long would after a short time, and solely through the pressure of the higher water, acquire as much velocity as if the tube were only one foot long", a result with which he is quite satisfied, although the fact that water stirred in a basin soon comes to rest might, on a little consideration, have led him to doubt his deduction.

Boyle, Huygens, Descartes, and Leibniz are the chief names of interest to the physicist which occur in the letters. Of Galileo there is nothing; Spinoza writes solely of his contemporaries. We cannot help regretting that his early death deprives us of any comment on Newton, whose "Principia" did not appear until ten years after Spinoza's death. It is nevertheless astonishing, and does little credit to Oldenburg's perspicacity, that Oldenburg has

nothing to say of Newton, whose work on the colour of thin plates was communicated to the Royal Society long before the correspondence closes.

For the production of the book, and for Prof. Wolf's work as translator and editor, we have nothing but praise. We know of none else who combines technical philosophical skill with knowledge of the history and spirit of science in a sufficient degree to undertake successfully a task like this, which is beyond the scope of the specialised philosophy of the present day. We are furnished with an admirable introduction, comprising a sketch of the scientific background of the correspondence and biographical details of the chief personages concerned, some tolerably obscure; with comprehensive and illuminating notes, such as only a profound student of Spinoza and of the period could write, and an excellent index. What more could be demanded? E. N. DA C. A.

The Mysore Tribes and Castes.

The Mysore Tribes and Castes. By the late H. V. Nanjundayya and Rao Bahadur L. K. Ananthakrishna Iyer. (Published under the Auspices of the Mysore University, Mysore.) Vol. 2. Pp. vii + 559 + 80 plates. (Bangalore: Mysore Government Press, 1928.) 12.8 rupees; 20*s*.

IT is now nearly thirty years since the late Sir Herbert Risley initiated the systematic ethnographical survey of the larger Indian Provinces and certain native States. Much useful work has been produced on the lines then laid down for the work of the survey, notably the "Tribes and Castes of the Central Provinces", by the late Mr. Russell, who was fortunately able to complete his four volumes before he so tragically fell a victim to the War. We have here Vol. 2 (which seems to have preceded Vol. 1) of a similar work on the tribes and castes of Mysore, taking us from Agasas to Budbudkis in a volume of 559 pages. A similar range in the records of the Bombay ethnographical survey ("Tribes and Castes of Bombay", 1920–22. Enthoven) occupies only half this space, so that the Mysore records, before completion, threaten to fill many volumes.

If this volume has taken some time to produce, and the completion of the survey seems still somewhat remote, much credit must be allotted to the editors for the fullness of the materials and the care with which they have been handled. Tribal origins, endogamous and exogamous divisions, birth, marriage, and death customs are dealt with systematically. Perhaps a little more attention might have been given to the so-called exogamous sections which are the subdivisions of the tribe or caste inside of which marriage is not permissible, that is to say, a bride of one such section must find a bridegroom in another. In many cases these sections are totemistic, named after a tree, plant, or animal. In view of the importance which attaches to these survivals of totemism, which has attracted special attention in the adjacent Province of Bombay, somewhat fuller details of the *balis*, as they are called, would have been welcome.

We believe that the editors are correct in assuming the identity of Ramoshis and Bedars in their excellent article on that well-known tribe. The Bedars, after pressing north into the southern portion of the Bombay Presidency, appear to have acquired the Marathi language and to have been renamed Ramoshis. As a thieving community they are to this day allowed to live on a form of blackmail in the Deccan by being employed as night watchmen in private residences at a reasonable salary, equivalent to insurance against the attentions of their fellow tribesmen.

We find in the account of the fishing caste known as Bestas, the equivalents Toreya, Ambig, Kabber, and Gangamakkalu (that is, children of the Ganges). Other well-known synonyms are Kabbligar and Kabera. Here it may be observed that, unfortunately, the authors of this work have not adopted the practice of showing in separate entries all synonyms for caste and tribe names and for the names of their divisions. For a student not well versed in the subject such entries are invaluable. In their absence, he is quite unable to find a caste or tribe unless he knows the particular synonym under which the survey record shows it. One or two minor criticisms also seem called for. The quotations from the works of other writers, though apparently meant to be verbatim, are in places not quite accurate. Palegars are referred to indifferently as Palayagars and Paleyagars. The well-known author of the "Tribes and Castes of the Central Provinces" appears invariably as Russel. An interesting but surely quite irrelevant picture of the beautiful Gersoppa Falls is included in the illustrations. It is not obvious how such an addition to the work can help to throw light on the habits and customs of the tribes and castes of Mysore; and in such works some literary reticence is essential, if the dimensions are to be kept within reasonable limits.

These criticisms made, we should like to congratulate the remaining author warmly on the result of his efforts, as well as to deplore the loss

f Mr. H. V. Nanjundayya. The writer of this otice was in close touch with Mr. Nanjundayya uring the early days of the work in Mysore. It s to be regretted that this learned worker has not urvived to witness the publication in final form f his very valuable contribution to the study of ndian ethnography. R. E. E.

Infra-Red Spectra.

nfra-Red Analysis of Molecular Structure. By F. I. G. Rawlins and A. M. Taylor. (The Cambridge Series of Physical Chemistry.) Pp. xv + 176. (Cambridge: At the University Press, 1929.) 10*s.* 6*d.* net.

IN view of the numerous and important researches which have been carried out in the nfra-red region of the spectrum, it might appear urprising that until now there should have been o book in English dealing exclusively with this ranch of spectroscopy. The methods employed ave been most ingenious and diverse, and the esults will assuredly contribute as much to the olution of molecular problems as photographic pectroscopy has contributed to those of atomic tructure. Yet the experimental difficulties have o greatly restricted work in this field that there as been little demand for a book of this kind. Now that the significance of such researches is being ealised, whilst at the same time standard methods ave been to some extent developed, it is most esirable that the knowledge which has been acuired with so much labour and difficulty should e made more easily accessible to the student and rospective worker in this field.

The four chapters of the work which is at present nder notice deal successively with the infra-red pectra of gases, liquids, and solids, and with exerimental methods. A really comprehensive or etailed treatment is naturally out of the question n a book of this size, but the authors have succeeded in compressing a quite remarkable amount f information into the limited space available. The mathematical appendix, in which, *inter alia*, a rief but unusually clear account is given of the pplication of wave mechanics to molecular vibraion and rotation, is particularly to be commended. The list of references at the end of each chapter ppears to have been compiled with discrimination, and is an extremely valuable feature.

The book is by no means a mere compilation. The authors themselves have worked extensively n these regions, and are therefore in a position to ontribute useful criticisms and suggestions. They suggest, for example, the desirability of substituting direct readings of prism orientation for the drum and lever arrangement in common use. In several places they emphasise, and very rightly, the necessity of measurements of intensity of absorption as well as of spectral position. In very few cases indeed have workers derived coefficients of absorption from their observations, being mostly content to plot galvanometer deflections against wave-length, and for no single substance, so far as we are aware, is the absorption coefficient known over any considerable spectral range.

There are a few slips which should be rectified in future editions. In two cases (pp. 131, 144) the credit due to the actual research worker is attributed to the author of a book in which his results are quoted. On p. 138 it is implied that the diffraction breadth of a spectral line is determined by the width of the entrance slit of the spectrometer, and one's suspicions of the unorthodox nature of the authors' views on resolving power are strengthened by the statement (p. 115) that it is, "as usual, proportional to the numerical aperture of the mirror". The account of photographic methods in the infra-red is distinctly inadequate, having regard to the important developments of the last few years.

Finally, a protest may be lodged against the ugly and unnecessary term "many-lines" spectrum of hydrogen. It is, of course, a literal translation from the German, but the already established term "secondary spectrum" is much to be preferred. In view of recent progress, it would seem still better to refer to it as "the band spectrum of hydrogen", or simply as "the H_2 spectrum". The book is well indexed and reasonable in price, and should find favour with chemists and physicists alike.

Our Bookshelf.

An Etymological Dictionary of Chemistry and Mineralogy. By Dr. Dorothy Bailey and Dr. Kenneth C. Bailey. Pp. viii + 308. (London: Edward Arnold and Co., 1929.) 25*s.* net.

THE aim of this dictionary is primarily *etymological*, and no attempt at exhaustive definitions has been made. Apart from its literary interest, however, its utility is, as the authors suggest, definitely enhanced by the inclusion of references. These, in many cases original, indicate where more complete definitions and descriptions of many uncommon minerals and chemical compounds may be found. Approximately 11,000 words are listed in the dictionary. These include many scientific terms, in addition to substances, though the work

is stated to be less complete with respect to terms than to names. The difficulty in finding a dividing line between chemistry and mineralogy caused the authors to include the latter science in a work originally intended to embrace only the former.

One point is well exemplified in this dictionary. This is the unfortunate and prevalent habit of naming minerals after places and people, without the slightest indication of chemical composition or physical properties. It is to be regretted that some form of nomenclature more akin to the usually rational and comparatively intelligible system applied to chemical substances has not been adopted for minerals.

Words current in the literature of the two sciences from the middle of the nineteenth century onwards are included, and the dictionary is sufficiently up-to-date to include names appearing in 1928. No important defects or omissions were noticed, and the work can be recommended as likely to prove a useful addition to scientific reference libraries. V. A. E.

Photometric Chemical Analysis (*Colorimetry and Nephelometry*). By Prof. John H. Yoe. With Contributions to Vol. 2 by Dr. Hans Kleinmann. Vol. 2: *Nephelometry*. Pp. xvi+337. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 22*s*. 6*d*. net.

THE volume contains a history of the development of nephelometers, an account of the theory of nephelometry, and examples of the use of the nephelometer in inorganic and organic analysis; it has a useful bibliography and satisfactory author and subject indexes. Prof. Yoe rightly lays stress on the necessity of studying systematically every reaction producing turbidity that it is desired to use in nephelometric investigations, as to the stability of the suspension and the limits of concentration that may be employed, and of standardising each instrument with each suspension used. Some squared paper is interleaved in the volume, serving the useful purpose of supplying a convenient place for the preservation of necessary calibration curves of the nephelometer in use. A table of atomic weights later than 1925 is not included. The volume is to be welcomed as providing a comprehensive study of nephelometric methods and an outline of the technique for carrying out nephelometric research. A. G. F.

The Custom of Couvade. By Warren R. Dawson. (Publications of the University of Manchester, No. 194: Ethnological Series, No. 4.) Pp. ix+118. (Manchester: Manchester University Press, 1929.) 7*s*. 6*d*. net.

THE strange custom of couvade, which consists of various taboos for and practices by the father of a new-born baby, more particularly his 'lying-in', has attracted the attention of many writers. Mr. Warren R. Dawson has evidently studied the subject to see how it would fit in with the migration of culture theory of Elliot Smith, but he can "merely throw out the suggestion that couvade *may* originally have been part of a religious ceremonial which was afterwards invested with new and varied significance and made a mere family concern. . . . We must, with Ploss, humbly admit that the state of our knowledge regarding the original motive of the couvade custom is expressed by a single word—*ignoramus*." At all events, the author has done good service in bringing together a very large number of references and in clearing away some of the debris that has hitherto encumbered the discussion of couvade, and he has succeeded in his object of collecting into a convenient compass the material for a reconsideration of a puzzling and interesting problem.

A Text-Book of Pulmonary Tuberculosis: for Students. By R. C. Wingfield. Pp. xvi+401. (London: Constable and Co., Ltd., 1929.) 31*s*. 6*d*. net.

THE treatment of phthisis, as Dr. Wingfield points out in his preface, has been so largely taken over by special hospitals that the medical student at a general hospital has little opportunity for studying the disease. A brief course of instruction at a special institution is essential, and to assist the student in taking full advantage of it, this text-book has been produced. It gives sufficient attention to detail without being too long and exhaustive for easy study. The subject of treatment naturally fills a large section of the book; the student and general practitioner tend too frequently to consider this a matter entirely for the specialist, and to neglect the fact that the mode of life prescribed and learned at the sanatorium has to be carried out later under the supervision of the family doctor. It is of interest to observe that treatment by gold compounds has not been so entirely abandoned as was once thought, and that sanocrysin does seem to have a limited sphere of usefulness. The book is very well illustrated by radiographs and temperature charts.

Animal Psychology for Biologists. By Dr. J. A. Bierens de Haan. Pp. 80. (London: University of London Press, Ltd., 1929.) 4*s*. 6*d*. net.

THIS little book consists of three lectures on certain features of the psychology of animals, excluding man. In the first, Dr. Bierens de Haan insists on the independence of animal psychology as a science, dissociating it from subsistence on the kindred sciences of physiology and human psychology. He defines as its aim the study of subjective phenomena in animals, from the highest to the lowest, and offers evidence that even the amœba experiences these phenomena. The animal is discussed as a knowing subject in the second lecture and as a feeling and striving individual in the third. Dr. Bierens de Haan evidently regards mental evolution in animals as having reached a level much more approximating to man's than is generally accepted. He considers that in higher animals there can be "an implicit understanding of the connexion of causes and effects", a psychological process equivalent to a primitive form of conceptual thought in man. Whether one agrees or not with his conclusions, they are a welcome stimulus to research in the many problems in this science still awaiting solution.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The General Applicability of Fechner's Law in Colour Sensation.

HELMHOLTZ long ago remarked that, in the matter of sensation of light, we have to deal with quality as well as quantity. That is to say, in physical language, luminous sensation is a vector quantity; and, since experiment indicates that it is a vector quantity of three dimensions, tridimensional vectors are appropriate to its geometrical representation.

Without any reference whatsoever to a Cartesian scaffolding, we can represent two different luminous sensations by two vectors, α and β, say, and the quaternionic operator $\beta\alpha^{-1}$ is the active operator which transforms α into β. It must therefore contain in itself data for a specification of the changes of sensation which are present in the passage from the one sensation to the other. These may be expressed in various ways; for example, in terms of independent changes in the intensities of three fundamental sensations, or in terms of changes of intensity, hue, and saturation. But it is not possible to attain to any results apart from experimental guidance as to the laws which have to be satisfied.

Now there was available to Helmholtz, for the development of his idea, no experimental information beyond that expressed in Fechner's law, either in its simplest or in its more extended forms. Yet he used it, in its simplest form, very effectively, in the investigation of differential sensitivity throughout the spectrum. In its next simplest form, he used it, very effectively too, in the explanation of variation of colour with intensity. He also based upon the action of self light a more general expression for it, which, as applied to the observations of König and Brodhun, has been found by Clara O. T. M'Kenzie to give remarkable correspondence over the whole range of intensity from nearly dazzling magnitude to approximate invisibility. But, as no other fundamental law was known at the time, he was unable to proceed further in the direction of the discrimination of expressions for hue and saturation. "I have the feeling", he said, "that in equating luminosities of different colours, the question is not that of comparing one-fold magnitudes but two-fold magnitudes compounded of brightness and colour glow, for which I cannot give any simple summation, and which I cannot scientifically define further." Experiment was needed to give data for the discrimination. Abney's additive law for component brightnesses was not then formulated.

If we consider the colour vectors α and β, without making any specification of *how* intensities of sensation are involved in their tensors $T\alpha$ and $T\beta$, we can express the transforming factor, which, acting upon α, producing β, in the form

$$q = \beta\alpha^{-1} = \frac{T\beta}{T\alpha}(UV\alpha\beta)^{\frac{2\theta}{\pi}}.$$

Here, in the apt Hamiltonian notation, $UV\alpha\beta$ is a unit vector normal to the plane containing α and β, and θ is the angle between these vectors. We must regard the tensor factor in q as associated with intensity, and the versor factor as associated with colour quality. Now we can take the step which Helmholtz was unable to take, and determine another quaternion Q which will be directly expressive of the corresponding sensations. To satisfy the simple form of Fechner's law we may write

$$Q = \log q = \log \frac{T\beta}{T\alpha} + \log (UV\alpha\beta)^{\frac{2\theta}{\pi}},$$

where the first term on the right-hand side is a scalar quantity, while the second is a vector which only vanishes when $\theta = 0$. The latter must therefore in this case represent the change of colour sensation, and the former the change of the intensity sensation, as the light changes from the type α to the type β. But, if we adopt this expression, we must regard the intensities as being represented by the tensors; in which case the corresponding geometrical construction (Lambert's pyramid) would compel us to take the square of a resultant intensity as equal to the sum of the squares of the component intensities.

Now this is in direct opposition to Abney's law. But, before considering that point, we may find what, on this scheme, is the measure of the colour sensation change. We have

$$\log (UV\alpha\beta)^{\frac{2\theta}{\pi}} = \theta \, . \, UV\alpha\beta,$$

and so $\theta = TVQ$ directly measures the change in colour sensation. But, if we take the quaternion

$$Q' = 2 \log q = \log \left(\frac{T\beta}{T\alpha}\right)^2 + \log (UV\alpha\beta)^{\frac{4\theta}{\pi}},$$

in order to get Fechner's law we must regard the tensors as representing the square roots of the intensities—a condition which might perhaps have been guessed at since intensity (measurable as energy) is the square of the tensor of a vector. This geometrical construction seems to have been first used by W. Pauli, jun.; and it directly expresses Abney's law.

The vector term in Q' is $2\theta UV\alpha\beta$, which gives $TVQ' = 2\theta$ as the measure of the change in colour sensation. Schrödinger's representation, which gives this result, is therefore equivalent to the postulate that the sensation changes correspond directly to the components of the quaternionic operator which transforms the one colour vector in Pauli's space into the other: the change in the sensation of intensity being twice the logarithm of the scalar part of the operator, while the change in colour sensation is twice the logarithm of the versor part.

Thus Fechner's logarithmic law applies alike to intensity stimulus and to colour stimulus. Of course, experiment alone can settle whether the proportion is one of equality or not. It may be, for example, that we should take $Q' = 2 \log q + V \log q$, the first term alone being doubled. In that case the change of colour sensation would be measured by the angle between the vectors themselves and not by double that angle.

It is useful to express Q' otherwise. If γ be any unit vector, we have

$$Q' = \log \left(\frac{T\beta}{T\alpha}\right)^2 + \log \frac{(UV\beta\gamma)^{\frac{4\theta_2}{\pi}}}{(UV\alpha\gamma)^{\frac{4\theta}{\pi}}},$$

where θ_2 and θ_1 are respectively the angles between the vectors β and γ, α and γ. So

$$\begin{aligned} Q' &= \log \left(\frac{T\beta}{T\alpha}\right)^2 + \log \left\{ \left(\frac{UV\beta\gamma}{UV\alpha\gamma}\right)^{\frac{4\theta_1}{\pi}} (UV\beta\gamma)^{\frac{4(\theta_2-\theta_1)}{\pi}} \right\} \\ &= \log \left(\frac{T\beta}{T\alpha}\right)^2 + \log \gamma^{\frac{2\psi}{\pi} \cdot \frac{4\theta_1}{\pi}} + \log (UV\beta\gamma)^{\frac{4(\theta_2-\theta_1)}{\pi}} \\ &= \log \left(\frac{T\beta}{T\alpha}\right)^2 + \psi \frac{4\theta_1}{\pi} \cdot \gamma + 2(\theta_2 - \theta_1) UV\beta\gamma, \end{aligned}$$

where ψ is the angle between the planes (β, γ) and (α, γ).

If γ be the white vector, the third term represents the change in the sensation of saturation as we pass from the colour vector α to the colour vector β; and the second term gives the corresponding change in the sensation of hue. It is evident from the form of the curve in Maxwell's triangle that, on this representation, the peculiar shape of Helmholtz's differential insensitivity curve arises in connexion with variation of hue.

The representation of Q' as a sum of three logarithms is an extension of Fechner's law for brightness.

W. PEDDIE.

University College,
Dundee.

Parasitic Autotomy in Worms and its Possible Significance.

WHILE examining certain Enchytræid worms for the stages of two cœlomic gregarines having periods of infection at different times in the year, namely, spring and autumn respectively, I found that the cœlom quickly became free from cysts at the end of the life-cycle of each type.

During June and July of 1929 I kept six heavily infected worms in the laboratory for the purpose of allowing the parasites to attain a certain stage in development. In the first week in August four of these worms were removed for examination and the remaining two left in the soil. On examining the latter two weeks later (Aug. 24) I found that both had lost the posterior segments, while the cœlom of one was free from parasites and that of the other contained a single cyst only.

Autotomy caused by parasites has been described in Echinoderma and in Polychæta, and Hesse ("Contribution à l'étude des Monocystidées des Oligochètes", *Arch. Zool. Exp. et Gén.*, 1909, (5), III., p. 27 à 301) mentions it as a possible mode of dissemination of parasite spores from the cœlomic cavities of Oligochætes. Dr. Keilin (*Parasitology*, **17**, pp. 170-172; 1925) has observed parasitic autotomy to be one method of liberation of the spores of gregarines from the cœlom of such earthworms as *Allolobophora* and *Helodrilus*. In my specimens of Enchytræid worms, large phagocytic cysts such as Dr. Keilin describes are not formed, but the cysts of the gregarines do tend to mass together in the posterior region, and there they displace and press upon the intestine. I have seen heavily infected worms showing constriction of the body and have noted many instances of regeneration of the terminal segments, but until now have never obtained proof of the actual loss of this part of the body. Two results follow: first, the spores are shed into the soil, where they may be taken up by, and infect, other worms—a simple method of disseminating infection; and, secondly, the cœlom is cleared before the invasion by the other type of gregarine which enters it very soon after the cycle of the first is completed.

When the parasites are present in the head region, the cysts accumulate in the segments anterior to the reproductive organs. I have not had the opportunity of keeping such a specimen for any length of time, but have frequently observed very heavy infection in this region. Further, on several occasions I have found worms in which the head region was being regenerated, and have also seen two examples of a length of an Enchytræid worm regenerating both head and "tail". Perhaps parasitic autotomy occurs in the head region also?

MABEL FULLEGAR.

Natural History Department,
University College, Dundee, Oct. 24.

The Physical Identity of Enantiomers.

IT has always been stated that, apart from the sign of the rotation and the solubility of their salts with optically active bases or acids, the physical properties of dextro and lævo enantiomers are identical. In an investigation (*Jour. Chem. Soc.*, 1111; 1929) of certain physical properties of the liquid active and racemic esters of tartaric acid, it appeared that in the case of this series there is a great difference in the degree of association of the active and inactive forms. It is usual to attribute association to something of the nature of the 'a' factor of the van der Waals' equation, that is, to stray fields, free energy, etc., in the immediate neighbourhood of the molecule, and, when this action takes place between molecules of the same kind, it is thought to be physical rather than chemical in its nature. If, now, we suppose combination to have taken place between the dextro and lævo forms, energy will have been evolved, and the stray field reduced, with consequent decrease of the degree of association. This is the observed fact; the inactive form is less associated than the active.

In view of the above, and of the fact that the existence of racemic compounds in the solid state (in certain cases, at least) has never been doubted, it seems that chemical combination can take place between dextro and lævo forms, and that this action is different from that acting between molecules of the same form to produce association. Therefore, there must be a slight difference in chemical nature between the opposite active forms, since, if there were not, they would combine together to the same extent to which they combine (associate) with themselves. Finally, if there is a difference in chemical nature, there must also be a difference in physical properties. It has always been assumed that there is no difference, and, since the difference is no doubt slight between, for example, the freezing points of the dextro and lævo forms, it may very well have been overlooked or attributed to experimental error.

It is possible, however, to determine certain physical properties with very great accuracy, and an investigation directed, first towards the preparation of both active forms in a state of the highest purity, and, secondly, to the determination of such physical constants, for example, the freezing points, as are susceptible of very accurate determination, would perhaps yield results of great theoretical interest. In an investigation of this kind, the utmost care must be taken in purifying the materials, in drying thoroughly (and to the same extent in each case), etc. The freezing point, solubility, and specific rotation are properties which can be determined with great accuracy. I am investigating the physical constants of the esters, simple and substituted, of tartaric acid. In view, however, of the very great experimental difficulties involved in the preparation, and of the scepticism with which positive results may be received, it is very desirable that similar work on other series should be undertaken by other workers.

A. N. CAMPBELL.

Department of Chemistry,
University of Aberdeen.

Alternating Intensities in the Spectrum of Nitrogen.

THE rotational Raman bands excited by the $\lambda 2536$ mercury line in nitrogen and hydrogen show the alternating intensities characteristic of a symmetrical molecule with a nuclear spin. In my communications on the subject (NATURE, May 18, 1929; *Proc. Nat. Acad. Sci.*, **15**, 515; 1929) I reported the lines

corresponding to transitions between even numbered rotational levels to be the strong ones in N_2, while the opposite is true for H_2.

In a recent letter to *Die Naturwissenschaften* (**34**, 373; 1929), Heitler and Herzberg pointed out that the result obtained on N_2 is rather surprising, as the symmetry of the electronic wave function in the normal state $^1\Sigma$ is the same in nitrogen as in hydrogen. This leads to the conclusion that the nitrogen nuclei satisfy the Bose-Einstein statistics, which appears in contrast with their structure consisting of seven electrons and fourteen protons.

In view of the importance of the problem, I have thought it worth while to check the experimental result with new measurements. The frequencies of the Raman lines had been determined by comparison with the spectrum of the iron arc. If a relative displacement between the Raman spectrum and the comparison spectrum had occurred (although every care had been taken to avoid this source of error) it would have been possible to mistake the even numbered rotational lines for the odd ones.

I have therefore made new measurements, taking only mercury lines in the spectrum of the scattered light for reference. In two plates, the exciting line λ2536 is not too over-exposed, and a fairly accurate reading of its position is possible. This enables one to distinguish the even and odd numbered lines without further reference. Moreover, the sharp mercury line λ2534·77, ν39439·8, provides a good standard, and appears to coincide very accurately with a strong line of the Raman spectrum. This affords another independent method of deciding the question.

Accurate measurements made with the two different methods and by independent observers have confirmed the former result. The measured frequencies of the strong lines usually agree with those calculated on the assumption of even quantum numbers within one frequency unit, whilst a systematic error of eight frequency units would be necessary to cause a misinterpretation.

I may remark here that, in the case of oxygen, the electronic wave function of the normal $^3\Sigma$ state is antisymmetrical, because, according to Mulliken (*Phys. Rev.*, **32**, 186; 1929), the structure consists, in addition to closed shells, of two electrons in $3p\pi$ states, which have parallel spins and can be shown to give an antisymmetrical contribution. As only the odd-numbered rotational levels are present, it follows that the oxygen nuclei satisfy the Bose-Einstein statistics. This is what we should expect of a structure of sixteen protons and eight electrons.

F. Rasetti.

Physical Laboratory of the Royal University,
Rome, Oct. 20.

Monœcious Oysters.

In Nature of June 8, Ikusaku Amemiya gives a list of five species of oysters recorded as being monœcious, and later, July 6, Paul Pelseneer adds two additional species, making a total of seven altogether. The only monœcious species in this list recorded from Australasian waters is *Ostrea angasi* (the correct name has now been determined as *O. sinuata* Lamarck). After a careful examination of large numbers of oysters from the South Island of New Zealand, and also of the oysters which have been introduced from there into the Derwent River in Tasmania, I have come to the conclusion that the New Zealand oyster is specifically distinct from *O. angasi*. Hutton's name, *O. lutaria*, will therefore stand, and this species is parviparous and hermaphrodite.

Then, too, during a recent investigation of the oyster resources of Queensland I chanced across an unidentified species carrying larvæ in the mantle cavity. *O. lutaria* and this unidentified species must be added to the list of recorded hermaphrodite oysters.

Every species in this list appears to be of the larviparous type, but the commercial oyster of New South Wales and Queensland (*O. cucullata*), although oviparous, was shown by me to undergo a sex-change (Nature, Sept. 29, 1928).

The list of monœcious oysters will therefore now embrace *O. edulis*, *O. sinuata* (=*angasi*), *O. lurida*, *O. denselamellosa*, *O. plicata*, *O. equestris*, an undeterminable species from Saleh Bay (Sumbawa), and *O. lutaria*, *O. cucullata*, and an undetermined species from the Queensland coast, making ten in all.

T. C. Roughley
(Economic Zoologist).

Technological Museum,
Sydney,
New South Wales.

Vibrating Air Column of High Frequency.

In the course of some experiments recently carried out in these laboratories, a curious series of annular markings was observed in a glass tube through which air, carrying water-vapour and powered charcoal, was passing under diminished pressure. The accompanying photograph (Fig. 1) shows the regularity of

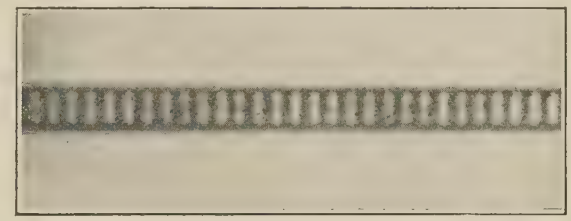

Fig. 1.

the distribution of the rings, of which 48 occupied a length of one decimetre. The diameter of the tube was 4·5 mm., and the pressure at the time of the experiment was approximately 600 mm. of mercury.

It is tentatively suggested that the phenomenon is due to supersonic vibration possibly originating at the narrow inlet and thence communicated to the air column. On this assumption a frequency of about 150,000 vibrations per second would be indicated. So far as we are aware, this figure is the highest yet recorded.

S. K. Crews.
F. C. Hymas.

The British Drug Houses, Ltd.,
Graham St., City Rd., N.1,
Nov. 5.

Balloons for Upper Air Work.

Since 1926, balloons made of 'Vulpro' rubber tissue, manufactured by the Vultex Products, Ltd., London, have been made use of in the India Meteorological Department with gradually increasing success. These balloons are made at the Upper Air Observatory, Agra, more or less after the method described by Mr. J. H. Field in the *Memoirs of the India Meteorological Department*, vol. 24, pt. 5. Considerable difficulty was at first experienced in joining the tissue, but after extensive trials it was found that satisfactory joints

could be made without difficulty by ordinary Dunlop rubber solution diluted with carbon tetrachloride.

The rubber balloons imported for pilot and sounding balloon work have been found to deteriorate very rapidly in India in spite of storage in the cold; and the adoption of 'Vulpro' tissue has been of great advantage for the development of upper air work in India. No special storage seems necessary, and the tissue, even a year after its manufacture, seems scarcely to deteriorate in quality. The percentage of premature bursts in case of the 'Vulpro' rubber balloons is almost negligible; hence they have been of immense service for ascents where risk of failure cannot be taken.

As an illustration of their performance, it may be mentioned that balloons $2\frac{1}{2}$ ft. in diameter made of tissue 0·004 in. thick and weighing about 150 gm. have taken Dines's meteorographs with accessories weighing 110 gm. up to a height of 20 km.

G. CHATTERJEE.

Upper Air Observatory,
Agra, India,
Oct. 24.

Electric Charge in its Relation to Complement Fixation.

ALTHOUGH the effect of specific immune serum, in the presence of a suitable electrolyte, in reducing the charge carried by bacteria has been thoroughly investigated, no work has been done on the relation of electric charge to complement fixation.

We have been studying this and other allied problems during the last two years and have shown that although sensitisation of red cells takes place in the absence of an electrolyte, specific hæmolysis cannot occur unless the charge of the red cells is reduced. For this an electrolyte is essential, and the concentration which is necessary depends upon the valency of the cation, provided that the salt in question has no deleterious action upon the complement. On the other hand, the effect of polyvalent anions is to maintain the high negative charge carried by the red cells, in which case hæmolysis does not occur.

We have shown that complement, considered as an entity, is negatively charged, and we are of opinion that the nature of the charge carried by the various components is one of the most important factors in the process of complement fixation and certain other immunological reactions.

We propose to deal with the matter more fully in the next number of the *British Journal of Experimental Pathology*.

H. C. BROWN.
J. C. BROOM.

Wellcome Bureau of Scientific Research,
33 Gordon Street, London, W.C.1,
Oct. 25.

The Second Spark Spectrum of Lead.

THE second spark spectrum of lead was recently analysed by K. R. Rao and ourselves; and a preliminary report of the series regularities discovered was published in a paper (*Ind. J. Phy.*, vol. 2, pt. 4, pp. 468-476.) We have since become aware of a similar publication by Smith (*Proc. N. A. S.*, vol. 14, pp. 878-880; 1928). There is a good agreement between our results and those of Smith, except in the identification of $1\,^3P - 1\,^3S$. Evidently he has our $1\,^3S_1$ as his $1\,^3P_1$. Carrol has very irregular intensities for the lines suggested by him. The $1\,^3S_1$ suggested by us is supported by the location of the second series $1\,^3S - 2\,^3P$, $1\,^3D - 2\,^3P$, and $2\,^3P - 2\,^3S$. Furthermore, $1\,^3P - 1\,^3S$ suggested by us is given additional support by the closeness with which it follows the irregular doublet law, for the isoelectronic sequences, Hg I, Tl II, and Pb III. An interchange of his levels $1\,^3S_1$ and $1\,^3P_1$ would probably bring the whole scheme into alinement with ours. As a result of our attempts to get further regularities, we have been able to get $2\,^3P - 2\,^3D$ and $2\,^3P - 2\,^3P$ as well.

At the time of publication of the above paper, not much progress had been made in the identification of the singlet spectrum. Attempts have since been made to identify this, and all the important lines arising from combinations between the singlet terms and intercombinations between the singlet and triplet terms have also been identified.

A. S. RAO.
A. L. NARAYAN.

Kodaikanal Observatory,
August 1929.

Subjective Demonstration of the Existence of the Muscular Sense.

WHEN lying at full length in a bath of water, preferably salt, it is easy to demonstrate to oneself rather strikingly the existence of the muscular sense.

Allow one of the arms to float on the surface which, as is well known, it will do quite easily. When it has come to rest there, make an effort to raise it stretched out from the shoulder-joint. This, if done slowly and with all due attention to it, will appear to require considerable effort. Let the arm once more come to rest, and now proceed to submerge it; again the effort required will be very evident in consciousness.

If similar observations are made with the leg, the sense of effort needed to raise it and submerge it is again strikingly brought out. This purely subjective demonstration of the muscular sense may be recommended as a method of experiencing muscular sensations without the use of the more or less elaborate apparatus of the psycho-physical laboratory.

D. F. FRASER-HARRIS.

Chiswick, W.4,
Oct. 21.

Amphibious Centipedes.

AMONG the Research Items in NATURE of Aug. 3, p. 209, the occurrence of marine centipedes is noted in Madras, other records being the Mediterranean, Atlantic coasts of Europe, and the shores of the Gulf of Mexico.

After a considerable experience of shore collecting, I can add the Cape Verde Islands in 1904, and the Galapagos in 1924. In the former case the centipedes inhabit crevices in the crust of *Melobesia* and *Vermetus* tubes, which covers all rocks at low tide inside bays, as described in the *Proc. Zool. Soc.*, p. 170, 1905; in the second case, large empty barnacle shells, also at low tide level and surrounded by a purely marine fauna. Marine spiders, which I had never seen since I obtained one in Zanzibar, among coral, in 1901, were found here also. The last was described in the *Proc. Zool. Soc.* about 1902, but the other three remain unexamined in the Cambridge and British Museums.

CYRIL CROSSLAND.

Pa'ea, Tahiti,
Oct. 4.

Medical Research: The Tree and the Fruit.[1]

By Sir WALTER MORLEY FLETCHER, C.B., K.B.E., F.R.S.

UP to quite modern days, the physician followed the strict Hippocratic tradition of concentrating his powers upon the welfare of the individual patient. He relied greatly, if not chiefly, upon rest in bed and upon the *vis medicatrix naturae*. He gave drugs for the palliation of symptoms, but had few, if any, weapons for attempting the specific cure of disease. His art, an art highly developed and refined, almost expended itself upon diagnosing accurately the exact process and the end result of the disease. I am not forgetting, of course, the exercise of his skilled functions in the right management of the patient's state of mind and in giving sympathetic and practical help to his friends—functions which in the physician's art at its best have always invested his office with a high nobility. But through the past generation, it has been his medical and non-medical colleagues in the scientific laboratory who have been putting into the physician's hands new weapons of precision, in the forging of which he has played little part himself and the mode of action of which he has to take largely upon trust.

The new sciences of organic chemistry and pharmacology have been yielding many new drugs artificially built up in the laboratory, that have specific and measurable actions upon particular microbes causing disease. Of these, salvarsan may stand as a type. Chemistry and pharmacology together have also given a new meaning to some of the oldest drugs that after immemorial use by native tribes have been prescribed by physicians for many generations. The infusions of the ipecacuanha root have long been used for the treatment of dysentery. Bacteriology has shown that dysentery is of two quite different kinds which earlier medicine had treated as one. One kind is due to infection by a particular group of bacteria; the other kind is due to organisms like the amœbæ belonging to the class of protozoa. Workers in India showed that it was the alkaloidal constituent of ipecacuanha which had this curative action, and later that this constituent, emetine, had its specific action only upon the amœbæ of dysentery and not at all upon the bacterial dysenteries. This specific action has been lately studied by new methods in the National Institute for Medical Research, and the path is open for an advance towards new and still better remedies for amœbic dysentery.

Cinchona bark, again, has been used as a remedy for malaria in Europe for two or three centuries. Of its various alkaloids, quinine was early isolated, and the physician concentrated upon this without any evidence that it was superior in its anti-malarial action to the other alkaloids present in the bark that were thrown away when commercial practice attended only to the quinine. This arbitrary choice of one constituent, although we now know that other cinchona alkaloids have effective anti-malarial actions, dictated the policy of selecting the species of the cinchona tree which yielded most quinine, irrespective of other important considerations, with the result that the world-price of the remedy practically available in commerce was kept disastrously high. In quite recent years the properties of the other alkaloids have been more thoroughly studied, and now the chemical laboratory has already produced a synthetic compound the action of which approximates to that of cinchona bark and gives hope that an effective and cheap specific may finally take its place.

Besides the specific remedies of this kind now provided as weapons of more precision for the physician, another important group of remedies has come into his hands. These are the so-called hormones—substances naturally produced within the body for the chemical control of particular functions. Knowledge of these is the result of the steady development during a whole generation of this branch of physiology, and British workers have played an active and most distinguished part in it. Some of these hormone bodies, for example, adrenalin, which controls the activity of the muscular coats of the blood vessels, intestines, and other organs supplied by the sympathetic nervous system, have a known chemical composition and can be made artificially. Most of them can only be prepared by extraction from the appropriate organs and have a molecular construction so large that it has not yet been chemically described. One of the most familiar of these, the active principle of the thyroid gland which the physician uses to remedy inborn or accidental deficiency, has lately been isolated and chemically described in London, and to this brilliant achievement, long the ambition of workers in other countries, has been added that of artificially constructing the molecule and so of synthesising the active principle 'thyroxin'.

Much has been heard lately of insulin, now used for the treatment of diabetes. This is a chemical substance of composition still unknown that is naturally produced within the body to control the use and disposition of the sugar-like substances derived from food which, roughly speaking, are concerned in the combustion processes supplying energy. A child or adult with inborn or incidental deficiency of insulin suffers from diabetes. He sinks into ill-health, kept at bay only by rigorous discipline, and he is faced by the prospect of increasing distress and an early death. These sufferers become as by magic normal and healthy persons if insulin is given to them from outside, and they remain normal so long as it is given. Those who would wish to belittle any result derived from animal experiments, even when the result derived is so great a work of mercy as this, are fond of asserting that insulin does not cure the disease. It is true that it does not remove the

[1] Abridged from the fifth annual Norman Lockyer Lecture of the British Science Guild, delivered on Nov. 19.

underlying cause of the deficiency, but it makes good the deficiency itself. It brings comfort and normal life to the diabetic sufferer for so long as its supply is maintained, just exactly as food brings comfort and life to a starving man, and for so long as it continues to be given.

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It amounts to a truism to say that progress in the practical arts of medicine in any of its branches, whether preventive or curative, only comes from the growth of accurate knowledge as it accumulates in the laboratories and studies of the various sciences. We find it a law of our state of being that, where only observation can be made, the growth of knowledge creeps; where experiment can be made knowledge leaps forward. The observation and description of diseases by physicians over many centuries have led to almost imperceptible advance. The experimental method, only fully and widely applied in the last generation or two, has given more progress in each decade than all earlier recorded history.

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Mankind naturally will always be eager for practical progress in medical work. Every layman now knows something of the many recent triumphs in medical science, but he knows also that these are isolated and incomplete. He sees clearly that, rapid as our progress has been within a period of years, amazingly short when compared with the preceding centuries, we are not in sight yet of anything like a victory over disease all along the line. It is a commonplace to complain that a common cold can be neither prevented nor cured. Every human child obtains its first lesson about the state of medicine by discovering that, as each infectious disease comes in its turn, the doctor has no magic beyond that of giving rest and warmth in bed. The general case-mortality rate for grave infections like those of pneumonia or puerperal fever has remained almost stationary for many years. The cause of acute rheumatism in children with its pitiful tale of subsequent heart disease is still unknown to us.

Every schoolboy knows the romance of the discoveries of the causation of malaria and its mode of transmission; he has learned in his geography lesson of the triumphant control of malaria and yellow fever that allowed the construction of the Panama Canal. But even in this region of tropical disease the layman sees that something is wrong and that our present knowledge does not allow us to press forward to final success. Yellow fever is still entrenched in West Africa, where it broods as a continual menace to the rest of the tropical world, its potential dangers being greatly increased by the modern possibilities of rapid transport. As to malaria, we have to admit that there are probably more rather than fewer sufferers in the world as a whole, though more than thirty years have passed since Ross under Manson's direction proved its insect transmission. We know enough to free a limited area from the disease if enough money be spent. Much more knowledge is required before we can hope for wider success in a general campaign. A hundred million sufferers in India alone must wait for relief until some generations of betterment have been traversed or until some increase in our knowledge brings, as we have every right to hope, some new kind of power.

To rest satisfied with our present achievements would indeed be a counsel of despair, and nothing could be more foolish or inhuman. Though our failures and deficiencies may be great, yet the successes already gained in the last few years, which are but as a brief moment in the history of man, should give us boundless confidence. Only the growth of scientific knowledge can bring success, and every victory must wait, as we know, upon the efforts of the unseen army of scientific workers. Practical statesmanship will turn at once to consider how that army can be aided and how it can be augmented. Let me quote Bacon again from his "Advancement of Learning". Three centuries ago he wrote: "If you will have a Tree bear more fruit than it has used to do, it is not anything that you can do to the boughs, but it is the stirring of the earth and putting new mould about the roots, that must work it". To turn this advice of his into practical effort to-day, we must consider in respect of our scientific army the primary questions of recruitment, of pay and of status, and I will take those points in turn.

As to recruitment, it can only be in the universities that the ablest young brains will be caught for the service. While it is true, indeed because it is true, that as Burke said, "the State is a partnership in all science, a partnership in all art, a partnership in every virtue and in all perfection", that Government will always be wise that makes the universities strong and leaves them free.

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If the service of research workers is to be recruited and maintained, questions of pay and status must have paramount importance. So lately as until just before the War, it was the almost universal rule in Great Britain that nobody should be paid for doing research work as such. Unless a man had private means, he could only keep himself at research work by being paid to do something else which very commonly conflicted with it. Much of it has always been done, of course, by university professors and other teachers heavily burdened with routine official duties. Salaries in academic life are in general indefensibly low. Even now professors who may be most eminent men of world-wide reputations, are fortunate if they receive £1200 a year, which was the low normal standard fixed by the recent Royal Commission for Oxford and Cambridge, and only a few with special administrative responsibilities receive £1500. These are salaries which men reaching eminent success in any other walk of life would regard as an offence, and even in the academic world the headmaster of a great public school would think of them derisively. In the junior university posts the salaries are relatively even lower. A man of distinguished ability, whether in teaching or research, may count himself lucky if after an expensive training and years of toil he earns £500 a year before he reaches thirty years of

age. It is true that since the War the nation has greatly increased the resources of the universities by direct grants made through the University Grants Committee, and indirectly by the funds made available for the several departments responsible for promoting research work in the three fields of agriculture, medicine, and industry respectively. Those bodies have done much to remove the discredit of starvation wages for scientific men, but it is obvious that they cannot do more than lead the way in the right direction and not so rapidly as to bring dislocation to the university systems.

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Not only fairness, but also enlightened self-interest should provoke any nation to bring the pay of competent research workers to such a level that they may hope in middle life at least to be able to bring an education as good as their own within the reach of their children. Until that is done, we are in practice ensuring the sterility of those who, almost by definition, must be counted as amongst the most desirable begetters of our future stock.

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The community has been turning more and more eagerly for fruits ripe for its own service from the tree to the development and nurture of which it has given such small care. We have been calling for the better cure of our own sicknesses and better health for our great industrial populations. Now this call is being reinforced by another, by a call for the scientific help for which the development of our Empire overseas has been waiting and upon which it is dependent at every point. There can be no right government of any part of our Empire and no true advance in the industries and welfare of the peoples within it except in the light of truth, truth in the fundamental matters of human life, of animal and vegetable life, and in the less primary but indispensable affairs of industry. No secure progress can be made save under the guidance of those who have knowledge of the realities of Nature and of the methods by which that knowledge has been gained and can alone be extended.

This lesson is at long last beginning to be painfully learned, and already the governments, both central and local, are seeking for men competent at first hand in the methods of biological and other sciences. They are seeking most urgently of all for men competent to investigate and to remove the primary disabilities opposed to all industrial development by causes of human disease or ill-health and by the diseases of the animals and the crops on which man's life depends. But they have been confronted at once with a plain dearth of competent and available men, whether in the fields of medicine or of agriculture; and so much so indeed that official representations have been made by the Government to the British universities upon the need for an increase in the supply of able men trained in the biological sciences and competent to advise them. I believe firmly that not only the development of the backward parts of the Empire but also the very maintenance of the Empire itself in its present political form depends upon the satisfaction, and the early satisfaction, of that demand.

Our schools and universities are filled to overflowing with eager and daring youth, and our race has never failed to produce minds apt for original enterprise and discovery. Why is there this shortage of men, therefore, for work that brings the finest intellectual exercise and that gives immeasurable opportunities for service to the State in its need and to mankind at large and for ever? I think the reasons are plain, and they are well understood and have long been declared by the British Science Guild. They are reasons found in national habit and reasons found in details of present method. Our long-standing national habit, derived chiefly from the non-Grecian narrowness of centuries of unbalanced classical education—a narrowness which has hitherto denied the application of scientific method even to the technique of linguistic teaching itself—has fostered a distrust, or at best an ignorance, of the study of natural causes and of the power that it brings. Our statesmen hitherto have not been bred to trust in scientific method and to call upon it for aid. The families with the best resources, and so with the greatest responsibilities for leadership, have not in general thought it natural or even quite respectable for their sons to turn from the old traditional employments to the new avenues of public service in science to be found, for example, in medical or agricultural research.

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I have tried to bring to your minds a conception of the organic growth, with its ramifications, of a tree of knowledge making the whole body of known biological truth. I have spoken of the largely unseen body of men upon whose efforts its growth depends. Mankind, helpless otherwise, has gained new powers over suffering and fuller life already from the fruits of this growing knowledge and waits anxiously for new powers again that may add to those boons. If we look at the brief period in which our present knowledge has grown, a period making an almost imperceptible point of time in the immense ages still stretching before mankind on the globe, we are encouraged to look confidently forward to a long vista of scientific progress that will bring powers of control over the processes of life, of which we can scarcely at present conceive. They will bring with them resultant changes in human society in a thousand ways now almost unimaginable. The value to the community of a body of men and women working to gain that new knowledge upon which the possibilities of greater happiness and works of greater mercy will spring is great. But it is not to be measured in terms only of those material fruits. The moral health of the whole community must gain from the presence within it of a band of workers whose business it is to seek out the truth and whose work from its nature can only go forward in strict obedience to the truth and by means of its pursuit and expression without fear and without favour. As the Dean of St. Paul's has lately said, in the scientific

life " a keen mountain air " is breathed, and something of the tonic air of this must always serve to brace and to elevate the general community.

The true worker in natural science can owe no allegiance to any tradition however venerable, or to any master however beloved. In his work he can only serve and express the truth, and for him the truth is that which can be tested by the touchstone of an appeal to Nature. He must forswear any selfish or sectional allegiance : he is " nullius addictus iurare in verba magistri ", and that phrase of Horace has become in shortened form the familiar and honourable motto of the Royal Society. If we attempt to measure the value of the scientific life within the community, we must put in the first place not the material fruits that spring from it, but the service it does to our reverence for truth and for the beauty it portrays.

The Royal Research Ship *Discovery II.*

THE launch of a ship specially built for oceanographic research is an event sufficiently rare to merit some notice in these columns. She is intended for the work of the Discovery Committee, and is for service in the South Atlantic and Antarctic, where she will be employed in biological and hydrological investigations concerned mainly with whaling. She was designed by Messrs. Flannery, Baggallay, and Johnson, consulting naval architects to the Committee, and was built to the order of the Crown Agents for the Colonies by Messrs. Ferguson Bros. of Port Glasgow. She was launched on Nov. 2 by Mrs. J. O. Borley and has been named *Discovery II.* The title ' Royal Research Ship ' has been approved by H.M. the King.

The R.R.S. *Discovery II.* has an overall length of 232 ft., a beam of 36 ft., a moulded depth of 20 ft., and a draught of 16 ft. when fully loaded. She is built of steel, and in several structural features is specially designed for ice navigation. Her stem is cut away at the fore foot and is rabbeted to protect the edges of the plates from chafing. The shell plating is doubled in the bow and at the water line throughout her length, while in the fore part the frames are closely spaced and transverse beams fitted in order to resist ice pressure. She is driven by a single propeller and reciprocating engines and on her steam trials developed a speed of $13\frac{1}{2}$ knots. Her furnaces burn oil fuel, and the bunker capacity is sufficient to enable her to steam 7800 miles at full speed and more than 10,000 miles at economic speed.

The general arrangement is sufficiently shown in the illustration opposite. The wardroom is on the boat deck, with the chart room, a survey office, and the captain's accommodation above it. On the flying bridge there is a wireless direction finder and an indicating anemometer, both reading in the chart room. The wireless room is equipped for both long and short wave-lengths and is at the after end of the boat deck. Abaft it is the sick bay, which is provided with an X-ray apparatus. The main accommodation is on the lower deck, the petty officers being berthed aft.

The equipment for sounding comprises a Kelvin machine on the bridge deck, a Lucas deep-sea machine on the forecastle head, and both shallow and deep water echo-sounding apparatus of the latest Admiralty pattern. Bottom sampling instruments of various kinds will be carried, including two patterns designed to bring up cores of ooze in glass tubes.

For hydrological work and for vertical plankton nets three small winches are installed. Those on the forecastle head and abaft the engine room each carry 3500 fathoms of wire for deep-water observations. The third winch, placed on the well deck, has two drums of 500 fathoms capacity. These winches are used in conjunction with special davits, fitted with accumulators and recording sheaves and with electric lights for work at night. The hydrological instruments include a full equipment of water bottles of both insulating and reversing patterns, the Lumby surface sampler, the Merz-Ekman current meter, and two Carruthers current meters.

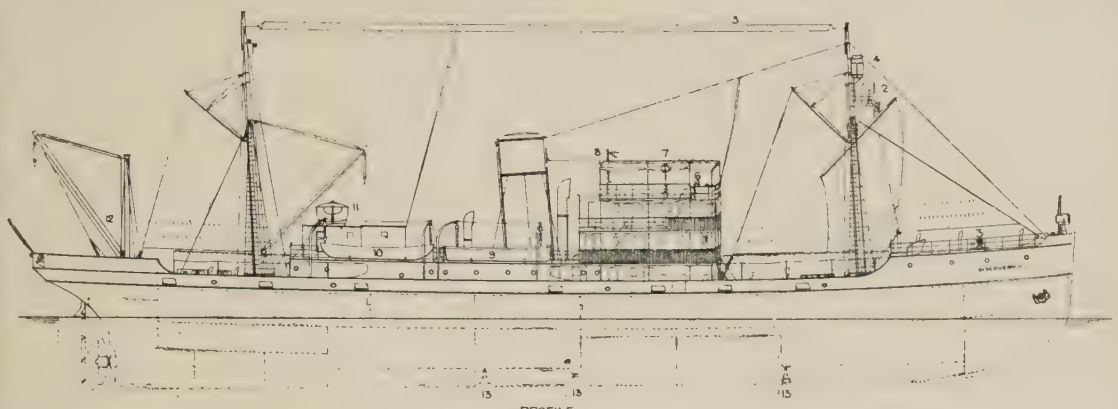
The main winch is placed abaft the engine room ; it carries two drums of wire rope, one 1000 fathoms, and one 5000 fathoms in length. The wire is led outboard by way of pedestal and stern fairleads, two of the former (one on either side of the ship) being fitted with recording dials to indicate the amount of wire paid out. A derrick is fitted on the poop deck for lifting heavy gear. The biological apparatus includes plankton nets of all sizes up to $4\frac{1}{2}$ m. in diameter of opening, the continuous plankton recorder designed by Prof. A. C. Hardy, traps, dredges, and 40 ft. otter trawls. Closing mechanisms and depth gauges are provided for use with the plankton nets and a Watts current meter for registering slow speeds in towing.

The internal accommodation for scientific work includes spacious biological and chemical laboratories on the upper deck, both lighted by square windows. The former has a large gimbal table, special arrangements for supplies of preserving fluids and racks for reagents and specimen jars. The latter is fully equipped for chemical analysis of water samples, and includes also a distance thermograph, giving a continuous record of sea temperature, a chart-tracing table lit from below, and the large oceanographic slide rule recently designed by Dr. Sund.

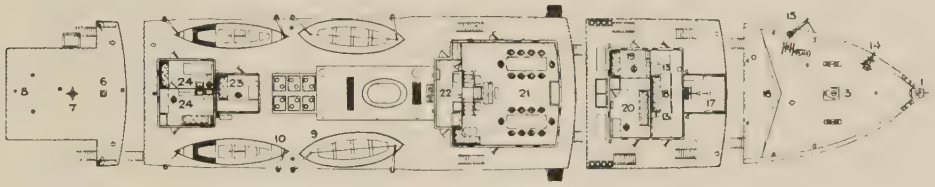
Immediately below the laboratories, and communicating with them by means of a service lift, is a laboratory workroom with a bench, tools, and other fittings. In this room is a large vertical camera with special lighting for the photography of marine organisms, and the dark room is at the forward end. Farther aft, in the accommodation on either side of the engine room casing, are an instrument room, a laboratory for rough work in which an electric centrifuge is fitted, and a store room for plankton nets.

The ship carries 15 officers (including a scientific staff of 6) and 35 petty officers and men. She is expected to sail from London about Dec. 14, and will be under the scientific leadership of Dr. S. Kemp, with Commander W. M. Carey, R.N. (retd.), in executive command.

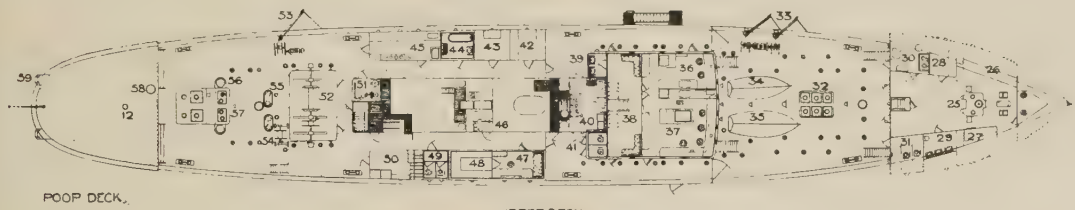
Royal Research Ship "Discovery II".



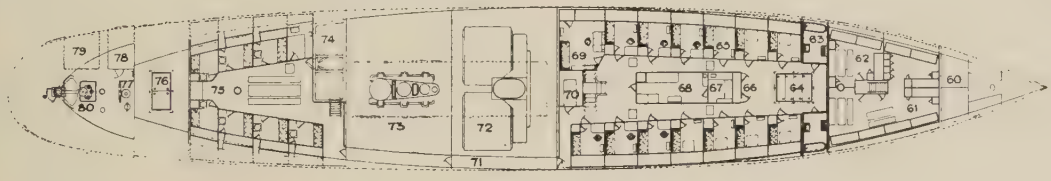
PROFILE.



FLYING BRIDGE BOAT DECK BRIDGE DECK FORECASTLE DECK.



POOP DECK. UPPER DECK.



LOWER DECK.

SCALE OF FEET.

1. Searchlight.
2. Alternative position for searchlight.
3. Capstan.
4. Crow's-nest.
5. Wireless aerial.
6. Standard compass.
7. Direction finder.
8. Semaphore.
9. Life boat.
10. Whaler.
11. Motor boat.
12. Derrick.
13. Echo sounding apparatus.
14. Lucas sounding machine.
15. Deep water hydrological machine and davit.
16. Breakwater.
17. Steering-house shelter.
18. Chart room.
19. Survey office.
20. Captain's cabin.
21. Wardroom.
22. Pantry.
23. Wireless office.
24. Sick bay.
25. Windlass.
26. Carpenter's bench.
27. Boatswain's store.
28. Drying room.
29. Crew's wash-house.
30. Crew's galley.
31. Crew's W.C.
32. Skylight to officers' accommodation.
33. Shallow water hydrological and plankton machines and davits.
34. Pram.
35. Dinghy.
36. Chemical laboratory.
37. Biological laboratory.
38. Lobby.
39. Lavatory.
40. Officers' galley.
41. Officers' W.C.'s.
42. Boot and oilskin drying room.
43. Instrument room.
44. Petty officers' bathroom.
45. Rough laboratory.
46. Fire extinguishing apparatus.
47. Office.
48. Canteen store.
49. Petty officers' W.C.
50. Plankton net store.
51. Refrigerating engine.
52. Winch house and winch.
53. Deep water plankton machine and davit.
54. Auxiliary winch drum.
55. Pedestal fairlead.
56. Recording fairlead.
57. Skylight to petty officers' accommodation.
58. Torpedo hatch to steering engine.
59. Stern fairleads.
60. Chain locker.
61. Seamen's mess.
62. Stokers' mess.
63. Officers' bathroom.
64. Hatch to forehold.
65. Officer's cabin.
66. Linen locker.
67. Dark room.
68. Laboratory workroom.
69. Cabin of Director of Research.
70. Steward's store.
71. Communicating alleyway.
72. Boiler.
73. Engine room.
74. Refrigerating chamber.
75. Petty officers' accommodation.
76. Hatch to after hold.
77. Hand steering wheel.
78. Lamp room.
79. Vegetable locker.
80. Telemotor steering engine.

Obituary.

PROF. T. B. WOOD, C.B.E., F.R.S.

WITH the death on Nov. 6, at the age of sixty years, of Thomas Barlow Wood, Drapers professor of agriculture in the University of Cambridge, has passed away one of the giants of agricultural research of the last quarter of a century. His scientific labours were begun at a time when British agriculturists were still under the spell of the brilliant researches of Lawes and Gilbert at Rothamsted. Despite the work of these pioneers, however, the science of animal nutrition was in its infancy. The stockbreeder still fed his animals according to the time-honoured methods of his ancestors, and such terms as 'balanced rations', 'maintenance' and 'production requirements', were not to be found in his vocabulary. The results of Kellner's classical feeding trials in Germany were only just beginning to filter through to the attention of the scientific agriculturist in Great Britain.

The early years of this century, however, ushered in a long and fruitful period of agricultural inquiry. During this time, when fresh lustre was being added to the splendid traditions of soil and crop research at Rothamsted, T. B. Wood, at the sister institute in Cambridge, was engaged in studying the question of the efficient and economic feeding of farm animals. His great aim was to establish the application of the scientific method to the difficult problems of animal husbandry. That his labours in this field have been crowned with success is freely admitted on every hand. His name will live with those of Lawes and Gilbert, Kühn and Kellner. No greater and no juster praise can be bestowed upon his memory.

I suppose it was Prof. Wood's association with Norfolk farming, an association continued to the day of his death, which led him, in his earlier work, to investigate the composition and feeding value of the root crops. These researches were fruitful of remarkable results, which frequently have been recalled in these later days when controversy has raged round the desirability, or non-desirability, of feeding roots to dairy cows.

The wheat-breeding investigations of his colleague, Sir Rowland Biffen, led Prof. Wood to become interested in the problem of wheat strength. This problem presented, and still presents, difficulties of a baffling nature. Why do certain wheats yield flour which is capable of giving rise to shapely, well-piled loaves, whilst flour from other wheats is of little use for bread-making? Why do strong flours contain a tough, elastic gluten, whilst weak flours are characterised by a gluten of crumbly, putty-like consistency? No fixed answer has yet been given to these questions, despite mass attacks on the problem in recent years. It was Prof. Wood, however, who, by dint of ingenious experiments, first shed light into the dark recesses of this strange and perplexing phenomenon. His two long papers published in the *Journal of Agricultural Science* for 1907 still remain classics, and no treatise on the subject of wheat strength is complete without a full consideration of the conclusions he arrived at.

During the War, Prof. Wood's genius was employed in the service of his country. How well he succeeded in the difficult task of devising and administering schemes for utilising to the best advantage our impoverished supplies of feeding stuffs can only be appreciated fully by his colleagues of those troublous times. His was the mind which rejoiced in propounding big ideas and schemes and, what is equally if not more important, in seeing that they were properly carried into effect. On the cessation of hostilities he returned to Cambridge, and then began the most fruitful period of his career. It was at his suggestion that the present writer began a series of investigations into the nutritive value of pasture. If, as is sometimes suggested, the results of these investigations mark an epoch in the history of grassland husbandry, let it be remembered that it was at the suggestion of Prof. Wood that the researches were begun. Also at his suggestion, his intimate friend and colleague, Dr. Capstick, devised and built the large animal calorimeter which has been such a familiar sight to visitors to the School of Agriculture during recent years. By its help, Wood and Capstick were able to carry out important and fundamental researches into the maintenance requirements of swine at all ages between weaning and slaughter. This valuable work is being continued and expanded by Dr. Deighton, who for some years past has enjoyed the privilege of close co-operation with Prof. Wood in matters relating to the practical nutritional aspects of animal calorimetry.

Ably seconded by the staff of the Animal Nutrition Institute, Prof. Wood also conducted long and laborious investigations, by the method of comparative slaughter, into the production requirements of cattle, sheep, and pigs. As a result of these researches, it is now possible to draw up tables of the precise food requirements of farm animals at all ages and live weights. Compare this happy state of affairs with the general ignorance of thirty years ago in matters of feeding and obtain in that way a measure of the debt which agriculture owes to Prof. Wood's activities. Almost his last piece of work, carried out in conjunction with Mr. Mansfield, was to measure the maintenance and production requirements of ewes and lambs, a difficult investigation which called forth a display of great experimental ingenuity.

It is not merely as an experimentalist, however, that Prof. Wood will be remembered. He has also left his mark permanently on the philosophy of the subject. At this juncture it is only possible to refer to his teachings in respect of the rationing of farm animals. He demonstrated that the method of computing rations for milk-producing animals, by summing the separate requirements for maintenance and production, could be applied with equal success to meat-producing animals. He reduced his proposals to the form of the general equation:

$$R = Am + gc,$$

where R is the net energy of the ration, A the

(*Continued on p.* 813.)

Supplement to NATURE

No. 3134 NOVEMBER 23, 1929

Lightning.[1]

By Dr. G. C. Simpson, C.B., F.R.S.

WHEN we review the history of our knowledge of atmospheric electricity, we find that it can be divided into three well-marked periods.

The first of these periods opens with the suggestion made by a number of philosophers between 1730 and 1750, that the phenomenon of lightning is nothing more than an exhibition on a grand scale of the sparks which were then being drawn from the primitive electrical machines of that time. An Englishman, Stephen Gray, appears to have been the first to make this suggestion in 1735, but it was Franklin who forced the idea on the attention of men of science. Dalibard in France and Franklin in America were the first to show in 1752, by actual experiment, that electricity can be drawn from the clouds during thunderstorms.

Commencing with this startling success, the period extended for one hundred years, during which it was shown that the atmosphere is electrified not only during thunderstorms but also during fine weather, even when there is not a cloud in the sky. Numerous experiments were made, chiefly consisting of exposing insulated conductors to the atmosphere and observing their electrical state by means of crude electroscopes, generally of the pith-ball type. It was found that the electricity of the air undergoes a regular daily and yearly variation, and that the state of the weather plays a predominating part in determining the electrical state of the atmosphere. The results were, however, very vague, and as the observations were almost entirely qualitative, it was impossible to formulate any clear ideas or even to describe the results in any coherent way.

During the latter half of this first period, that is, during the first half of the nineteenth century, little progress was made and observations gave place to speculative theory. The decline of interest in atmospheric electricity coincided with the period in which the foundations of the modern theory of mathematical electricity were being laid on the classical work of Coulomb and Faraday. Amongst the pioneers of this new study of electricity was William Thomson, afterwards Lord Kelvin.

Thomson's interest in atmospheric electricity appears to have been aroused by his mathematical study of electrostatics. On May 18, 1860, he gave a Friday evening discourse at the Royal Institution on "Atmospheric Electricity", and with that lecture the second period of the history of atmospheric electricity opens. Thomson showed what the observations already made signify when expressed in terms of electrical charge on the ground and in the air. But, more important still, he introduced the idea of the electrical potential of a point in the air and showed how it could be measured and even recorded. For this purpose he invented his celebrated water-dropper, and the development of his three electroscopes—the quadrant, the absolute and the portable—was largely due to his interest in the measurement of atmospheric electricity. Electrical potential gradient in the atmosphere now became recognised as an important meteorological factor, a factor with a physical meaning and one which could be recorded continuously. In 1861 the first self-recording electrometer was installed under Thomson's direction at Kew, and this started the longest series of measurements of atmospheric electricity which exists. The series has continued to this day, although, I regret to say, not without some interruptions.

For the next forty years, work on atmospheric electricity consisted almost entirely of measurements of the potential gradient in all parts of the world, from north polar to south polar regions and from sea-level to the tops of the highest mountains. The whole of this work was dominated by Kelvin's mathematical theory and by Kelvin's methods. During this period our knowledge of the electrical field of the earth's atmosphere was greatly extended; but little advance was made in our knowledge of the causes of the electrification, and at the end of the nineteenth century the study of atmospheric electricity was again at a low ebb.

This lethargy was broken and the third period introduced by the discovery, during 1900 and 1901,

[1] The Twentieth Kelvin Lecture delivered before the Institution of Electrical Engineers on April 25, 1929; slightly abridged from the *Journal* of the Institution for November 1929 (Vol. 67, No. 395).

of radioactivity and of the existence of ions in the atmosphere. These discoveries led to renewed interest in atmospheric electricity and to the most rapid period of growth in our knowledge of the electricity of the atmosphere since the study commenced in the middle of the eighteenth century.

From this short review, it will be seen that Kelvin's work and influence played a very important part in the development of the science of atmospheric electricity. After his first epoch-making papers in and about 1860, Kelvin wrote practically nothing on atmospheric electricity; but he was always deeply interested in the subject, especially in the problem of the thunderstorm, and those who have read his contributions to the periodic discussions on lightning at the meetings of the British Association will know of the deep interest he took in the subject of this lecture.

Conductivity of Air and Clouds.

It is scarcely too much to say that nine out of every ten physicists would be prepared to give without any hesitation an explanation of a lightning discharge. They would say something like this: "During a thunderstorm a cloud obtains a charge of electricity which goes on increasing until a spark passes to another cloud or to the ground, in the same way that an insulated brass ball discharges when connected to an electrical machine". In other words, they consider that clouds floating in the air are conducting bodies which can be charged and discharged like any other conductors when their potential is raised sufficiently high. I hope to be able to show how completely wrong is this idea, and my best way of approach will be the historical one.

Almost from the very beginnings of electrical science, it has been known that air is not a perfect non-conductor of electricity. Charged bodies were observed to lose their charge in circumstances when there could be no leak over the insulation. At first it was considered that the loss was greatest when the air was damp, but, in 1887, Linss showed conclusively that this is not the case, for he found the loss to be greatest during fine weather when the air is dry. There was, however, considerable doubt as to the way in which the charge was lost, for it was difficult to see how a gas could be a conductor in the same way that a metal is a conductor, and it was very generally supposed that the molecules of the air striking the charged body took on a small charge which they carried away with them on their rebound. The well-known experiment in which the insulated bob of a pendulum vibrates between a charged and uncharged bell, so ringing them, was probably largely responsible for this idea. In any case it was impossible to disprove the suggestion, and it did seem to offer a reasonable solution.

The discovery of Röntgen rays and Becquerel rays led to a rapid expansion of our knowledge of the passage of electricity through gases. It was then found that the molecules of gases could be ionised; in other words, an electron could be driven out of one molecule, leaving it positively charged, while a neutral molecule could capture a free electron and become negatively charged. A molecule of a gas charged in this way is an ion, and I shall use the word 'ion' throughout in this sense. A positive ion, then, is a molecule of gas which has lost an electron, while a negative ion is a molecule of gas which has captured an electron.

In 1900 and 1901, Elster and Geitel in Germany and C. T. R. Wilson in England showed that clear, dust-free air always contains a number of positive and negative ions, and that it is the movement of these ions in an electrical field which makes air a conductor, the conductivity depending on the number of ions present and on their mobility. Subsequent work has shown that in the lower atmosphere there are generally about 500 ions of each sign in a cubic centimetre, and that they move with a velocity of about $1\frac{1}{2}$ cm. per sec. in a field of 1 volt per cm. A simple calculation shows that this gives to the air a small but definite conductivity, the magnitude of which is best expressed by saying that the resistivity of the lower atmosphere in clear weather is $4{\cdot}5 \times 10^{15}$ ohms. Swann has attempted to give some idea of the immense magnitude of this resistance by comparing the resistance of a column of air with a column of copper. "A column of air one inch long", he says, "offers as much resistance to the passage of the electrical current as a copper cable 30,000 million million miles long, and of the same cross-section, *i.e.* as much resistance as that of a copper cable long enough to reach from here to Arcturus and back 20 times."

The conductivity of the atmosphere when expressed in this way may sound very small, but it is far from being insignificant. In fact, it is so large that a charged insulated conductor exposed to the atmosphere loses some 3 per cent of its charge in a minute, that is, the bulk of the charge will have leaked away through the air in half an hour.

If we turn now to the electrical conditions within a cloud, we find a great difference. Within a cloud there are practically no ions, for even if ions are formed within the cloud as rapidly as they are formed in clear air, they cannot persist, for they are immediately absorbed by the cloud particles and

lose their mobility. Thus there can be little conduction of electricity within a cloud, and a cloud is one of the best insulators we have. In fact, I myself have exposed charged bodies within clouds and been unable to observe the least loss of charge in an hour or more. We must obviously change our picture of a thunderstorm, for in place of conducting clouds floating within a non-conducting atmosphere, we have to think of non-conducting clouds floating within a conducting atmosphere—a complete reversal of the general idea. So long as we were able to think of conducting clouds, we could draw pictures like those in the text-books in which the nearest point of one cloud 'sparks' to the nearest point of another cloud, and one charged cloud induces opposite charges on the upper and lower surfaces of a lower cloud. All these pictures must be dismissed when we accept that a cloud is a perfect non-conductor, for in an insulator the charge does not collect on the surface as it does on a conductor.

Later I shall describe the process which separates large quantities of electricity into different parts of the cloud, but at present I wish to fix attention on the electricity within the cloud without considering how it gets there. Any electricity within a cloud must be carried by the water in the cloud, either on the cloud particles themselves or on the rain, hail, or snow contained within the cloud. These charges can be very great, so great, in fact, that in the strong electrical forces associated with a thunderstorm the electrical forces on the raindrops may be actually greater than the force of gravity. As the charge accumulates in a certain part of the cloud, it must ultimately discharge either to an accumulation of the opposite sign in another part of the cloud or to the induced charge on the ground below. How this discharge is initiated and then propagated is a problem which has received very little attention from physicists. A great deal is known about the discharge of electricity through air from one conducting electrode to another; but in a thunderstorm there are no electrodes, or at most one electrode when the discharge passes to or from the ground.

The Mechanism of a Lightning Discharge.

I have already said that within the cloud the charge is attached to the water particles; if, therefore, the charge is to move, it must carry the water with it. Now we know that the mobility of a water particle, no matter how highly charged, is so small that no electrical field, short of that which will break down the air, can produce an appreciable current. In other words, there can be no discharge until there is electrical breakdown of the air. I must therefore say a few words about the process of ionisation and electrical breakdown of air.

Electrical breakdown in air at normal temperature and pressure occurs when the field strength reaches 30,000 volts per cm. With this field an electron attains such a high velocity during the short time that it is free, that when it impinges on a neutral molecule at the end of its free path, it has sufficient energy to drive one or more electrons out of the neutral molecule. These released electrons are in the same intense field and they repeat the process. The effect is obviously progressive, and in a very short time there are great quantities of free electrons all moving with high velocity along the lines of force. The rapidity of motion of an electron is of an entirely different order of magnitude from that of an ion in the same field. In fact, the difference is so great that we may consider that both positive and negative ions are, when compared with electrons, quite immobile, even in the strongest fields. Now positive electricity is always carried by ions; for protons, the elementary units of positive electricity are themselves atoms of matter and therefore are ions. As soon, therefore, as air breaks down, large quantities of negative electricity can move as electrons, while the positive electricity is held immobile on the positive ions.

As electricity of one sign is accumulated during a thunderstorm in one part of the cloud, and the opposite electricity in another part of the cloud, the field between them increases in intensity. This is represented in Fig. 1 (*a*) by the + and − signs, and the lines of force are indicated. As the charge is not uniformly distributed, the lines of force are not parallel, but approach one another in the region of strongest field at the junction of the two charges.

If the field strength increases sufficiently, breakdown will first occur along the line AB. As soon as this happens, a small region becomes a good conductor and the effect is exactly the same as if a piece of wire were introduced into the electrostatic field. The lines of force assume a new distribution, shown diagrammatically in Fig. 1 (*b*), and the field becomes greatly intensified at the ends of the conducting region where the lines crowd into the conductor.

In Fig. 1 (*c*) the region of breakdown is shown on an enlarged scale. The electrons have moved rapidly towards the positive charge on the left, leaving the right-hand half of the conducting region full of positive ions which, as already stated, may be considered to be immobile. This is the condition immediately after breakdown has occurred: the

subsequent changes are extremely interesting. On the diagram, arrow-heads have been added to the lines of force to indicate the direction taken by the electrons. On the left, the electrons will be dragged out of the conducting region into the surrounding un-ionised air, where they will slow up in the weaker field and be captured by the neutral molecules to

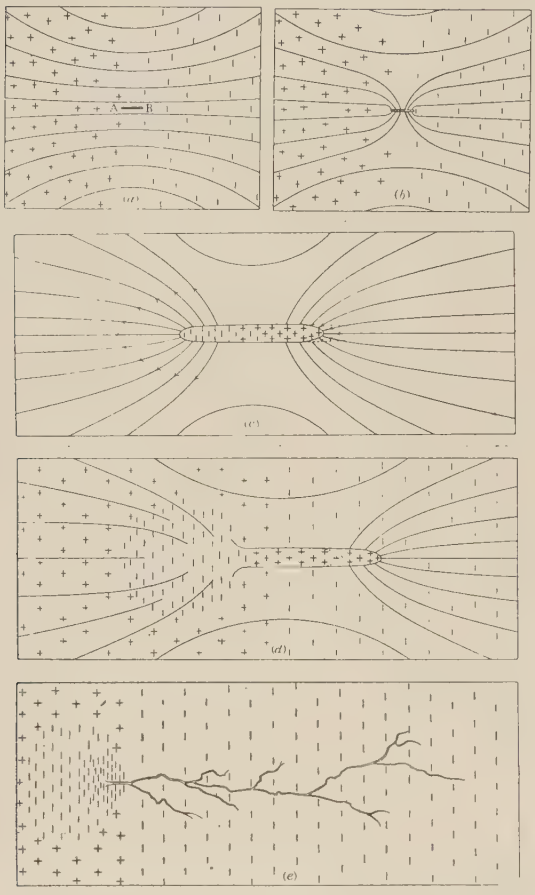


FIG. 1.—Diagram of the formation of a conducting channel.

form ions. These ions have little mobility and remain in a diffuse region around the end of the conducting channel.

The effect of this cloud of negative ions on the electric field is indicated in Fig. 1 (*d*), which shows that the initial intense field no longer exists at the end of the conducting region, because this region has been greatly enlarged and many of the lines of force find their ends on the negative electricity bound on the new negative ions.

If now we return to Fig. 1 (*c*) and examine the conditions at the other end of the conducting region, we find that they are entirely different. The channel is full of positive ions, but although the field tends to drag them out, they are too massive to move appreciably, and the shape of the channel remains unchanged. Owing, however, to the concentration of lines of force which took place when the air broke down, the field at the end of the conducting region is very intense, and within a space around the end of the channel, indicated by a dotted line in Fig. 1 (*c*), the air cannot withstand the stress and breaks down still further, with the liberation of further large quantities of free electrons. These electrons move at once into the conducting channel and, passing along it, keep the air within the channel highly ionised by their collisions with the air molecules. Ultimately they find their way into the cloud of negative ions at the other end of the channel. The transfer of the electrons from the newly ionised region at the end of the channel leaves that region full of positive ions; in other words, the conducting channel is simply prolonged as indicated in Fig. 1 (*d*). The process, however, cannot stop here, for the end of the growing channel remains sharp and the field at the tip is in consequence still sufficiently intense to ionise the air. Thus the channel prolongs itself rapidly in the direction opposite to the flow of the electrons, and far into regions where, before the discharge, the field was much too weak to cause the breakdown of the air.

Owing to fortuitous causes, the channel frequently branches in its growth, and we finally get a picture similar to that shown in Fig. 1 (*e*). This figure illustrates two very important properties of an electrical discharge through air at normal pressure: (1) The discharge once started makes a channel only in one direction, that direction being towards the seat of the negative electricity, while in the other direction there is no channel, only a diffuse cloud of negative ions; and (2) all the branches are in the same direction, that is, pointed away from the seat of the positive electricity. This is a most important point, for it enables us to identify the positive end of a lightning flash whenever branches can be seen.

So far, my description of a lightning discharge has been purely theoretical; but I have made a number of laboratory experiments which support the theory in all particulars. I have described these experiments in a paper "On Lightning" (*Proc. Roy. Soc.*, A, vol. 111, p. 56; 1926), and can only refer here to one experiment. Two copper discs to represent the charged region of a cloud, one positive and one negative, were placed on a photographic plate. Each disc had a small wire protuberance to concentrate the field. The discs were connected to a Wimhurst machine and a discharge was passed, with the result shown in Fig. 2. Here one sees the

long, thin channels, each sharply pointed, passing out of the positively charged electrode, while from the negatively charged electrode there are no channels but only a small cloud in the immediate neighbourhood of the wire point.

Types of Lightning Discharges.

When we wish to apply these results to the lightning discharges in a thunderstorm, we have to differentiate between three possible kinds of discharges :

(*a*) Discharges between oppositely charged regions of the atmosphere ;

(*b*) Discharges between positive electricity embedded in a cloud and the ground ; and

(*c*) Discharges between negative electricity embedded in a cloud and the ground.

(*a*) *Discharges between oppositely charged Regions of the Atmosphere.*—Fig. 1 showed the form taken by the discharge between two regions having positive and negative charges respectively. As the result of the discharge we are left with a large and diffuse cloud of negative ions within the positively charged region and a channel containing positive ions probably widely branched within the negatively charged regions. The discharge has destroyed the field, but it has not distributed the transferred charge very widely : this is effected by the normal turbulence within the atmosphere, which conveys the transferred charge into the surrounding cloud, where combination with the original charge takes place and the neutralisation is completed. We see that the discharge starts where the field is most intense, and the channel grows towards and branches into the region of negative charge.

(*b*) *Discharge between Positive Electricity embedded in a Cloud and the Ground.*—In Fig. 3 the shaded area represents a cloud in which there is a concentration of positive electricity indicated by positive signs. The discharge started at the lower edge of the charged area where the field originally had its maximum value. The direction of the discharge is towards the induced negative charge on the ground, and in the course of its development the channel branched. The amount of branching will vary greatly from storm to storm, and we can have every graduation from the unbranched, meandering flash to the heavy branched discharges which appear to accompany the most violent storms.

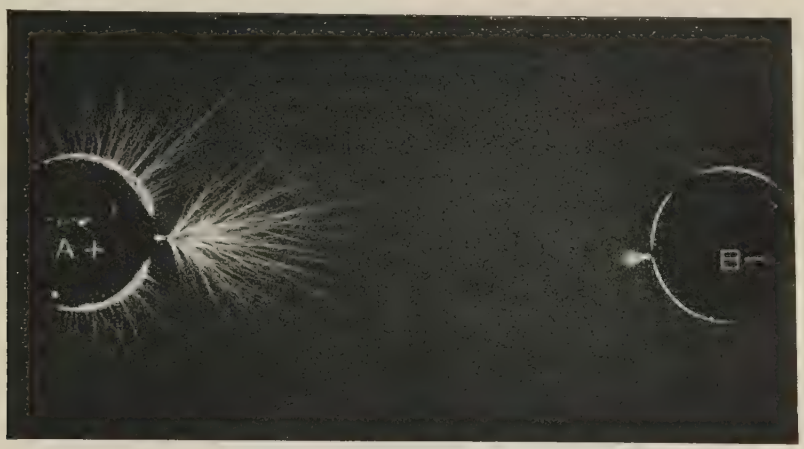


Fig. 2.—Discharges from positive and negative electrodes.

There can be little doubt that the formation of the cloud of negative ions around the end of the discharge plays an important rôle in the character of the discharge, for it reduces the field at the root of the channel and tends to prevent the flow of electricity along the channel. The channel may be actually blocked by the cloud of negative ions before sufficient negative electricity has been passed along the channel to neutralise the positive charge in the cloud. The discharge then ceases until either the block is removed or a side discharge opens a new passage between the end of the channel and another part of the cloud. In this way the discharge down the main channel may be intermittent, for the

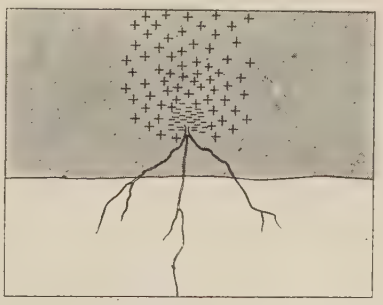


Fig. 3.—Diagram of discharge from positively charged region.

channel remains ionised for an appreciable time after each partial discharge has ceased.

The whole process as here described is well illustrated in two photographs taken by Prof. Walter of Hamburg with two cameras, one stationary and the other mounted on a revolving table. The photograph taken with the stationary camera is shown in Fig. 4. The fact that the branches converge to a point some distance within the cloud indicates clearly that the discharge did not start on the surface of the cloud, as would be the case if the cloud were a conductor. The photograph taken with the moving camera is shown in Fig. 5. The direction of motion of the camera was such that the first flash is shown on the right of the picture. It will be noticed that this was a single vertical flash. A little more than a tenth of a second later another discharge took place, which followed the channel of the first discharge to the point marked with an arrow and then made a new channel for itself—this accounts for the two chief channels shown on the stationary picture. There were then two more discharges at short intervals; then a period when the discharge, though diminished, did not entirely cease for more than a tenth of a second; finally, the discharge came to an end with two discharges at a short interval apart. The time interval between the first and last discharges was just over half a second.

In this example the branches are away from the cloud, so that there can be no doubt that the charge which gave rise to the flash was positive; and the intermittent nature of the discharge is satisfactorily explained by the blocking of the channel by negative ions which the theory has led us to expect.

If the accumulation of positive electricity is high up within the cloud, the channels may not reach the ground but end within the cloud. Unfortunately, it is impossible to get visual evidence of such shortened flashes because they are well within the cloud. If a branch should descend so low as to reach the bottom of the cloud and become visible, it would no doubt extend right down to the ground on account of the great increase in the field at the end of the channel as the ground is approached. Although the direct evidence which would be provided by photographs of lightning flashes ending in the air cannot be obtained, there is much indirect evidence for the existence of flashes of this type in the tropics, where the whole thunderstorm phenomenon takes place much higher in the atmosphere than is the case in the latitudes of Great Britain.

FIG. 4.—Photograph of discharge taken with a stationary camera. (Photograph by Walter.)

(c) *Discharges between Negative Electricity embedded in a Cloud and the Ground.*—The field below a negatively charged cloud before a discharge passes is similar to that below a positively charged cloud, except that the direction of the field is reversed. The air again breaks down at a point near the lower

edge of the charge; but the discharge cannot this time grow towards the ground—it must develop along the lines of force into the cloud. This is shown diagrammatically in Fig. 6. Unfortunately,

FIG. 5.—Photograph of same discharge as in Fig. 4 taken with rotating camera. (Photograph by Walter.)

it is not possible to show a photograph of a discharge of this nature, because the discharge would be entirely within the cloud and therefore hidden from the camera. There are also good reasons for believing that such discharges would be very rare, for no mechanism is known which concentrates negative electricity within a small region of the

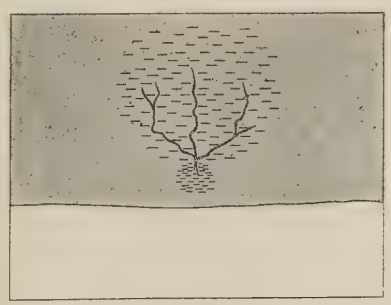


FIG. 6.—Diagram of discharge within a negatively charged region.

cloud, as is the case with positive electricity. For reasons which I shall explain later, negative electricity is generally diffused throughout a great mass of cloud. The electrical field under such an extensive cloud is relatively uniform, with vertical lines of force. The region of maximum intensity might not then be near the charged cloud but near the ground, where earth-connected irregularities such as towers, trees, hills, etc., concentrate the lines of force. If the sparking potential is then reached, it will be on one of these earth-connected projections from which a discharge will start, and the channel will develop rapidly upwards to the cloud, where it will branch as shown in Fig. 7.

It is very difficult to get photographs of flashes of this kind because the branching is nearly always well within the cloud. The finest photograph of a flash of this type which I have seen was taken by Mr. J. Craik at Herne Bay on the night of June 28, 1892; it is reproduced as Fig. 8.

Of the three types of discharge which we have considered—(1) the discharge within the cloud, (2) the discharge to the ground from a positive cloud, and (3) the discharge to the ground from a negative cloud—the two latter are of most importance to the electrical engineer, for it is these which strike buildings and overhead wires and do structural damage. But the characteristics of the two types of discharge to the ground are very different. The discharge from positive cloud starts high up in the atmosphere and branches out on its way to earth. An earth-connected object may therefore be struck either by the main trunk or by one of the branches. On the

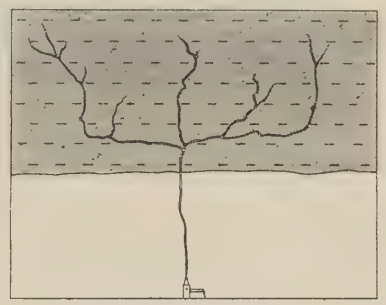


FIG. 7.—Diagram of discharge between a negatively charged region and the ground.

other hand, a discharge to a negative cloud starts on an earth-connected object, which takes the whole discharge. Thus the chances of being struck are much greater with a positive discharge than with a negative discharge.

If the same quantity of electricity is discharged from a positive as from a negative cloud, objects struck by the positive discharge will only receive a portion of the discharge, for a large part of the electricity which leaves the cloud is lost in the channel and in the branches, but an object struck by the negative discharge passes the whole electricity concerned in the discharge; therefore negative strokes will, in general, be more intense than positive strokes. I have also shown elsewhere that

positive discharges will normally be more frequent than negative discharges.

The theory which I have sketched leads to the conclusion that discharges from positively charged clouds would be frequent but weak, while discharges from negatively charged clouds would be infrequent but very strong. In order to test these conclusions, I have examined more than 400 photographs of lightning, and from the direction of branching determined the sign of the discharge. I was able to reach the conclusion that there are at least four times as many discharges between positively charged clouds and the ground as between negatively charged clouds and the ground, and there are good reasons for believing that the ratio is nearer 10 to 1 than 4 to 1.

Fig. 8.—Photograph of discharge at Herne Bay. (Photograph by Craik.)

The question of whether a lightning discharge is unidirectional or oscillatory exercised the minds of physicists to a great extent until quite recently. The question has now been finally settled by the direct observations made by Watson Watt, Norinder, and Matthias, who have shown by means of the cathode ray oscillograph that the main discharge in a lightning flash consists of a unidirectional current which starts from zero, rises to a maximum, and then decreases more or less rapidly to zero again.

In the light of the theory already given, this result is easily understandable. The essential of an oscillating discharge is a condenser which on discharging overshoots the mark, so causing a return current which recharges the condenser. So long as the cloud was considered to be a conductor which could be discharged like a Leyden jar, it was natural to conclude that lightning would be oscillatory. But we now know that a cloud is practically a perfect non-conductor and therefore has no capacity and cannot function like a Leyden jar. We should therefore expect on theoretical grounds that the main discharge would be unidirectional.

Lightning and Atmospherics.

There is, however, another factor which must not be overlooked. Although the cloud as a whole has no capacity, the conducting channel with its ramifications when once formed is a conducting system and therefore has electrical capacity and self-induction. In fact, we can picture the channel of a lightning flash to earth as a gigantic wireless aerial, and if its resistance is not too great it will oscillate like any other wireless aerial. By applying the ordinary formulæ I find that a vertical aerial earthed at its lower end, 2 km. high and 5 cm. in diameter, would oscillate if its resistance were of the order of 1 ohm per metre. There can be little doubt that the resistance of a fully developed lightning channel when most highly ionised may well be less than this and the channel therefore able to oscillate.

The oscillations will be superimposed upon the main current but will not reverse its direction of flow. In other words, the intensity of the unidirectional current of the main discharge will pulsate with the frequency of the natural period of the channel. The effect is somewhat similar to that of a 'singing arc', in which the conducting path through the air between the electrodes is maintained by a unidirectional current, while the oscillations which give rise to the musical note are superimposed upon the current according to the natural frequency of the circuit.

Now Norinder found oscillations of this nature superimposed on the lightning discharge investi-

gated by him, and Watson Watt found them highly developed on the atmospherics which he observed in Khartoum, as will be seen from Fig. 9. If, as Appleton supposes, atmospherics owe their origin mainly to lightning discharges, these ripples find their natural explanation in the oscillations within the lightning channel, as here suggested.

The wave-length of the radiation set up by the oscillations is approximately twice the length of the channel for channels with both ends in the air, and four times the length of the channel for channels which reach the earth. If we take 2 km. or 3 km. to be the average length of a lightning channel, the

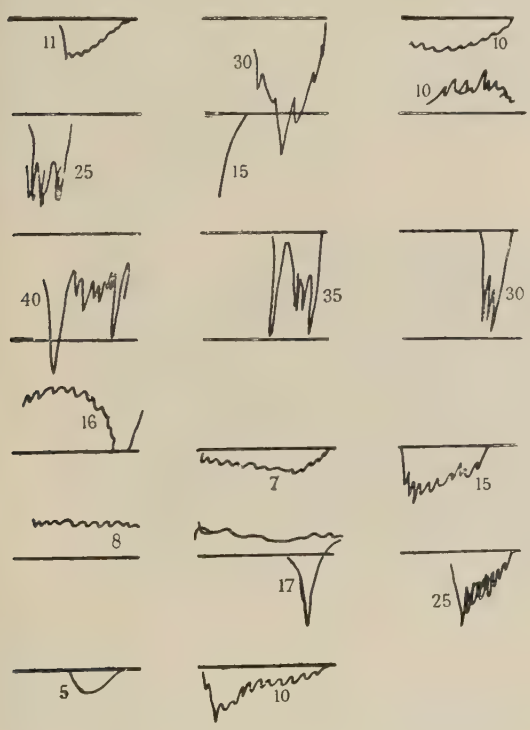


Fig. 9.—Wave-form of atmospherics observed by Watson Watt.

order of magnitude of the wave-lengths will be 10 km., while Watson Watt found that the order of magnitude of the wave-lengths associated with the ripples he investigated was 30 km., which is a satisfactory agreement.

It may be mentioned in passing that the wave-length of these oscillations, being of the order of 10 km., is well within the band of wave-lengths used in wireless telegraphy, and therefore oscillations formed in this way are probably the chief cause of the disturbances associated with atmospherics.

Quantities and Magnitudes.

It is of importance in all practical problems connected with lightning to know the order of magnitude of the electrical factors involved. We owe to C. T. R. Wilson the best knowledge we have on these points, and I will quote here his results without any attempt to describe the beautiful methods by which he obtained the data, beyond saying that they involved measuring the change of electrical field strength produced by lightning discharges at a known distance.

Wilson finds that the quantity of electricity discharged in an average lightning flash varies between 10 and 50 coulombs, and he takes 20 coulombs as being typical. This is a surprisingly small quantity of electricity, being merely 20 ampere-seconds, a quantity which would appear to be too insignificant to call for consideration by electrical engineers. Wilson was the first to fix by direct observation the quantity of electricity involved in a lightning flash, and that so recently as 1920. Yet that great genius Faraday in his earliest experiments on electricity, when the very idea of 'quantity of electricity' was just struggling to birth, had already obtained practically the same result. Faraday concluded that the electricity necessary to dissociate a single grain of water (700 coulombs) is "equal in quantity to that of a powerful thunderstorm".

With regard to the potential associated with a lightning flash, Wilson estimates that the potential reached in a thunder-cloud before the passage of a discharge of 20 coulombs is of the order of magnitude of a thousand million volts. Of course potentials of this order of magnitude are never fully reached at the earth's surface when a body is struck, because of the resistance of the air channel; but there is no reason why potentials of tens of millions of volts should not be reached when conductors, such as transmission lines, which are not directly connected to earth, receive a direct stroke. The energy associated with a discharge can be calculated directly from the quantity and the voltage. It works out to be 10^{17} ergs for a flash discharging 20 coulombs. Expressed in more familiar units, the energy dissipated in an average lightning discharge is of the order of 3000 k.w.h. Again, all this energy does not appear at the earth's surface, for much of it is used in the channel, but many of the most powerful strokes must deliver a large proportion of their energy to the earth.

A very important factor in connexion with a lightning discharge is the time element. Wilson has not determined this, but we have recent measurements by Norinder and Matthias, and, if we may accept the opinion that atmospherics are due to lightning discharges, we have the large mass of data collected by Watson Watt. All these deter-

minations agree in making the average duration of a lightning discharge greater than 0·001 sec. A discharge of 20 coulombs in 0·001 sec. gives a mean current of 20,000 amperes—a value agreeing well with the direct observations of current made by Matthias. This mean value must, however, be greatly exceeded for short periods during the course of a discharge, and we may well expect instantaneous values of the order of 100,000 amperes.

Mechanism of a Thunderstorm.

It is a great help towards understanding the varied phenomena of lightning to have some idea of the processes which build up the intense electrical fields associated with thunderstorms. Unfortunately, meteorologists are not completely agreed on this subject and no theory is universally accepted.

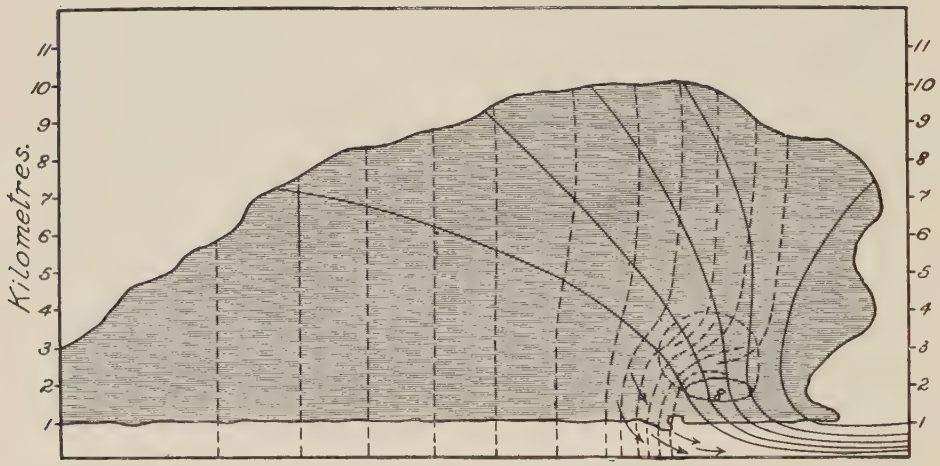


Fig. 10.—Diagram of thunderstorm—meteorological conditions.

In 1909 I suggested a theory which was amplified and worked out in detail in 1927, and as the critics of the theory have not suggested any alternative, I feel justified in giving it as at least an attempt to explain the mechanism of a thunderstorm.

Any theory of the electrical processes in a thunderstorm has to account for the initial separation of positive and negative electricity (or, shall we say, the generation of the electricity ?) and then for the transfer of the separated electricities into widely different regions of the cloud. In the theory which I am about to describe, the generation of the electricity is a consequence of the disruption of rain-drops, and is therefore called the breaking-drop theory ; while the separation of the electricity into different regions of the cloud results from the different velocities of cloud particles and rain-drops relative to the vertical air currents which are such a marked feature of all thunderstorms.

So long ago as 1892, Prof. Lenard showed that when pure water splashes against a solid obstacle electrification results, the water becoming charged with positive electricity while the negative electricity remains suspended in the air. In 1908 I made experiments in Simla extending Lenard's work and showed that the same separation of electricity takes place when a drop of water is broken up in the air without striking a solid obstacle.

It was natural to conclude that we have here the source of the electricity in thunderstorms. The next step was to consider the conditions under which drops are disrupted in a thunderstorm, and here again the work proceeded from previous work by Lenard. A drop of water falling through still air rapidly attains an ' end velocity ' which obviously will be different for drops of different sizes. Lenard had investigated the end velocity attained by drops of different sizes and found the values given in the lower half of Table 1.

Table 1.

Rate of Fall of Water-Drops through Air at Atmospheric Pressure.

Diameter.	End Velocity.	Authority.
cm.	cm./sec.	
0·001	0·3	Calculated by Stokes's formula
0·002	1·3	
0·010	32	
0·020	126	
0·100	440	Observed by Lenard
0·200	590	
0·300	690	
0·350	737	
0·450	805	
0·546	798	
0·636	780	

It will be seen from Table 1 that the end velocity

reaches a limiting value as the size of the drop increases (very nearly equal to 8 metres per sec.), above which it does not increase; it even decreases a little as the drop grows still greater. Lenard showed that this apparent anomaly is due to the drops becoming deformed, so that instead of retaining the shape of spheres they become flattened out, thus presenting an increased resistance to the air through which they fall. Owing to this deformation drops larger than about 0·5 cm. in diameter are unstable and quickly break up into a number of small drops. The practical application of this result is that water cannot fall relative to the air at a greater rate than about 8 metres per sec., and as a consequence no rain can fall through an ascending current having a vertical component greater than 8 metres per sec. Now it is a suggestive fact that violent currents much greater than 8 metres per sec. are a characteristic of all thunderstorms. Fig. 10 shows in diagrammatic form, but roughly to scale, the meteorological conditions in a thunderstorm of the heat type. The thin unbroken lines represent stream lines of the air, so that they show the direction of air motion at each point, and their distance apart is inversely proportional to the wind velocity. The air enters the storm from the right and passes under the forward end of the cloud, where it takes an upward direction. We are concerned mainly with the vertical component of the velocity, and it will be noticed that although the actual velocity decreases along the stream lines, the vertical component increases as the air passes into the storm and reaches a maximum in the lower half of the cloud. The oval marked 8 indicates where the vertical component is 8 metres per sec.; within the oval the vertical component is more than 8 metres per sec., and outside less. No water can pass downwards through this region, because the relative velocity between air and a drop having a diameter of 0·5 cm. is 8 metres per sec., and larger drops cannot exist, for they are unstable.

In the diagram (Fig. 10) the broken lines represent the paths of rain-drops. On the extreme left the drops fall practically vertically, while in the right half of the storm the falling drops are deflected to the left by the air stream. The magnitude of the deflection from the vertical will obviously depend on the size of the drops. Drops of the largest size will be little deflected, while the smallest drops—cloud particles—will travel practically along the stream lines. It is clear from the diagram without any further description that above the region of maximum vertical velocity there will be an accumulation of water. Only large drops will be able to penetrate into the lower part of this region to just above the surface where the vertical velocity is 8 metres per sec. These drops will be broken and the parts blown upwards. The small drops blown upwards will re-combine and fall back again, and so the process will be continued. The region in which this process of drop breaking and re-combining is large is indicated in the diagram by a dotted curve.

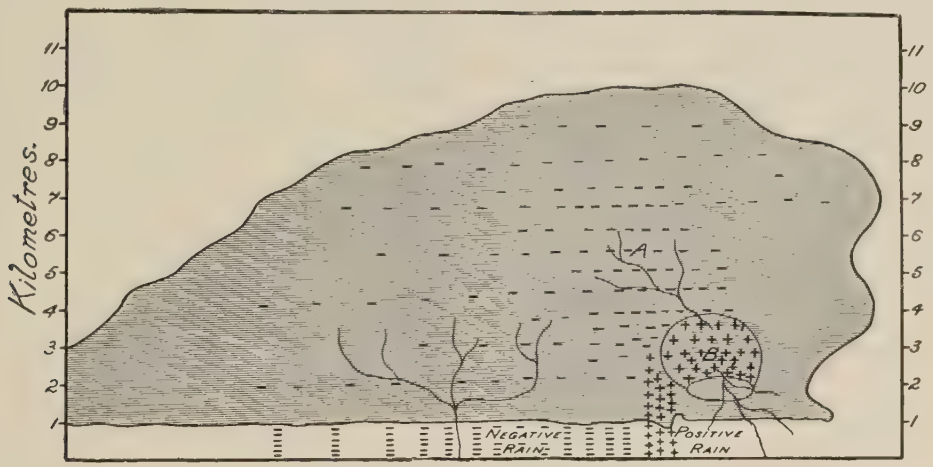


Fig. 11.—Diagram of thunderstorm—electrical conditions.

Turning now to the electrical conditions which will be associated with the meteorological conditions shown in Fig. 10, these are shown, also diagrammatically, in Fig. 11.

In the region where the vertical velocity exceeds 8 metres per sec., there can be no accumulation of electricity. Above this region is the place where the breaking and re-combining of water occurs—the region marked *B* in the figure—here, every time a drop breaks, the water of which the drop is composed receives a positive charge. The corresponding negative charge is given to the air and is

immediately absorbed by the cloud particles, which are carried away with the full velocity of the air current. The positively charged water, however, does not so easily pass out of the region *B*, for the small drops rapidly re-combine and fall back again, only to be broken once more and to receive an additional positive charge. In this way the accumulated water in *B* becomes highly charged with positive electricity, and this is indicated by the + signs in the diagram. The air with its negative charge passes out of *B* into the main cloud, so that the latter receives a negative charge. The region *B* may be described as the region of separation, for here the negative electricity is separated from the positive electricity.

The rain which falls out of the region of separation will obviously be positively charged, so one would expect the heavy rain near the centre of a storm to be positively charged. On the other hand, as one moves away from the region of ascending currents, one would expect the rain to be negatively charged, for it has fallen entirely out of the negatively charged cloud. Observations made on the electricity carried by rain confirm this distribution of positively and negatively charged rain.

Fig. 11 also indicates the types of lightning discharge which one would expect to accompany the electrical distribution here described. The chief point of origin of lightning discharges will obviously be the region of separation, for here one can have unlimited concentration of positive charge carried on the accumulated water. From this positive charge, discharges may pass towards the negative electricity in the cloud, but the most frequent discharges will be downwards towards the ground, some of which will reach the ground and some will end in the air, the latter type being the more frequent in tropical storms. There will also be occasional discharges from the ground towards the main cloud, which is negatively charged. These discharges will branch upwards, while those from the region of separation will branch downwards.

This, then, is the mechanism of a thunderstorm according to the breaking-drop theory; but of course, in Nature, the conditions are much more complicated than in the simple scheme here sketched. It is therefore not surprising that observations are occasionally made which it is difficult to fit into the scheme; but there can be no doubt whatever that it does explain all the chief facts of observation, in particular the distribution of positively and negatively charged rain and the frequency of the different forms of lightning discharge.

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surface area of the animal, m its maintenance requirement per unit surface area, g its gain in live-weight, and c the energy stored in unit live-weight increase. Where A, m, and c are known, and g is given a desired value, R, the net energy of the ration to be fed for the purpose of producing the desired rate of gain of live-weight, can be calculated. He demonstrated, further, that under certain conditions of experiment, the equation can be used for computing the net energy or starch equivalent of a feeding stuff.

Space forbids more than this fragmentary sketch of Prof. Wood's scientific work. To do this justice must form the theme of some future monograph. Nor can adequate reference be made to his influence as teacher and lecturer, his gifts as author and editor, his powers as organiser and administrator. His energy was amazing. It has well been said of him that for many years there was not an agricultural project of any importance on which he was not consulted before it was finally adopted. From modest beginnings he patiently developed an imposing organisation for teaching and studying agriculture in all its manifold phases. This was his crowning achievement. He was concerned also to house his subject worthily. Hence rose the School of Agriculture at Cambridge, which fair and gracious building is his enduring monument.

So much for the man and his work. On both, posterity will pass its judgment. But to us who mourn his loss, to us who shared his labours, his aspirations, his successes, and sometimes, alas, his disappointments, to us, in these early days following his death, it is the character of the man which stands out pre-eminently. Noble and just of temperament, with an infinite capacity for kindly thought and action, he endeared himself to all who came within his influence. How many of his younger associates, amongst whom the present writer, with gratitude, numbers himself, will cherish his memory through the years to come. Truly it may be said of him: his generation was the better for his having lived.

H. E. W.

WITH very great regret—a regret which is shared by his hosts of friends—I have read the news of the recent death of Prof. Wood. To the value of his stimulating work in many branches of agricultural science, many competent judges will give, or have already given, their testimony with far greater knowledge than my own. I confine myself here to the personal acknowledgment of the invaluable services which he rendered during the last three years of the War to the nation and to more than one great department of State, and especially to the Board of Agriculture. I feel that I should like to add something, if I can, to the memory of a most loyal colleague.

In December 1916, when I became president of the Board of Agriculture, farming in England seemed to be almost at its last gasp. The late Lord Oxford's "Reminiscences" contain a report to the Cabinet in the preceding autumn, which presents a striking picture of the widespread sickness that had gripped the industry. If any attempt was to be made to revitalise agriculture, a definite policy must be framed and steadily pursued. The note of the German Government that, on Feb. 1, 1917, the unlimited U-boat campaign would begin, emphasised the necessity for immediate action. The problem set the Board was the production, with the greatest possible speed, of the largest possible supply of indispensable food for the needs of a beleaguered city.

In the anxieties of this gloomy period, the visits of Wood were welcome as the sun. He seemed to radiate health, energy, and cheerfulness, and his optimism, when the difficulties were so obvious and apparently so insurmountable, was invigorating. He came to me fresh from the Food Council, of which he was a prominent member, master of its latest opinions, ready, with unfailing good humour, to explain their mysteries in simple language. He proved an excellent counsellor. We had to form an idea, as exact as possible, of the food requirements of the nation, of the constituent parts of a ration which should be physiologically satisfactory, of the quantities of each constituent required, and with these facts in our minds to concert the means for their supply. On all these initial points, which included a host of subsidiary questions, Wood was most useful. But he was especially valuable in reference to the most advantageous utilisation of the live-stock of the country for our purpose. Here his practical knowledge and experience came into full play.

Nor was it only in the inauguration of the movement that Wood's services were employed to advantage. In the summer of 1917 the reserves of frozen meat for the army were running dangerously low. Until the reserves could be restored, it was decided to feed the troops at home with fresh meat. Wood served on the committee set up for the purpose, with Mr. Gavin as its secretary. The work was done so efficiently and quietly that it passed unnoticed by the country. Another work on which he was engaged at the conclusion of the War was the compilation not only of exact details of the number and age of the cattle, but also of their whereabouts, so that no district should be disproportionately depleted. He even found time to direct the work of the committee formed to disseminate among farmers information respecting the use of feeding stuffs and approved methods of alternative feeding.

I have dealt only with my personal relations with Prof. Wood, and have not referred to his work on the Inter-Allied Scientific Food Commission in Paris and afterwards in Rome. At the former conference his influence is shown in the adoption, for all allied countries except France, of the policy pursued in Great Britain on the relation of live-stock to available food supplies. His War-work is a striking record of a most unassuming and lovable man who spent his great abilities and untiring labour in the cause of his country.

ERNLE.

News and Views.

THE Kelvin lecture delivered before the Institution of Electrical Engineers by Dr. G. C. Simpson, Director of the Meteorological Office, which appears in a slightly abridged form as a Supplement to this issue, will be read with interest. The valuable work Dr. Simpson has done in investigating the phenomena of lightning discharge makes everything he says worth careful consideration. In one or two places, however, he makes very definite assertions which, as our knowledge increases, will almost certainly have to be modified. For example, he says that the resistivity of the lower atmosphere in clear weather is approximately $4{\cdot}5 \times 10^{15}$ ohms. The values found for ebonite and sulphur are much greater than this, and good paraffin has a volume resistivity greater than 5×10^{18}. If air has this low resistivity, the values accepted by electricians for good insulators must be very inaccurate. We know that the resistivities of many insulators vary very rapidly with temperature, but some seem to remain constant. Dr. Simpson considers that during a thunderstorm we have non-conducting clouds floating within a conducting atmosphere, thus completely reversing our ordinary ideas. That lightning flashes could occur under such conditions will be readily admitted. We know that sparks take place readily between two pith balls. We always thought that the charge collected on the surface of an ordinary insulator. In Kelvin's theory, in which he explains the anomalous actions that occur when two pith balls of like sign are brought close together, it is assumed that the electricity is on the surface. It is difficult to believe that a cloud is a perfect non-conductor.

DR. SIMPSON'S theory of how the electrical energy is generated during a thunderstorm, the so-called 'breaking-drop' theory, can be readily accepted by the engineer. It originated in Lenard's discovery that when pure water splashes against a solid obstacle electrification ensues. Dr. Simpson then discovered that when a drop of water is broken up in the air without striking anything, the same separation of the positive and negative electricities takes place. The limiting velocity of a large raindrop falling vertically is about 8 metres per second (17 miles per hour). A drop larger than about 0·5 cm. in diameter is unstable; it becomes flattened out and quickly breaks up into a number of small drops. When it breaks up it receives a positive charge. Now it is known that some of the air inside a thundercloud is moving with a vertical velocity greater than eight metres per second. The resulting negative charge is given to the air and is absorbed by the cloud particles which are being carried upwards. We would expect, therefore, that the rain which falls where the air currents are vertical would be positively charged and that at a distance from this region it would be negatively charged. This is in accordance with observation. There will be occasional discharges from the earth to the negatively charged cloud, but the most frequent discharges will be downwards towards the ground, some of them apparently ending in the air. We hope that this lecture will give an impulse to the study of the phenomena of lightning, as, notwithstanding recent advances, there are still many difficulties to be explained. The phenomena of chain lightning and globular lightning have not been considered. An explanation of these curious occurrences would probably reflect light on the mechanism of an ordinary thunderstorm.

THE Nobel prize for physics for 1928 has been awarded to Prof. O. W. Richardson, for his researches upon the emission of electricity from incandescent materials, and in particular for his investigations of the laws governing the rate of emission of electrons. Prof. Richardson is a Yarrow research professor of the Royal Society, but continues to direct the research work of a large number of students at King's College in the University of London, where he held the Wheatstone chair of physics from 1914 until 1924. Richardson virtually created the subject of thermionics, and so long ago as 1901 "showed that the negative ionisation from hot metals could be satisfactorily explained by supposing that it was caused by the freely moving corpuscles inside the metal escaping from the surface when their kinetic energy exceeded a certain value", to quote from a paper by him in the *Proceedings of the Royal Society* for 1906. His monograph on "The Emission of Electricity from Hot Bodies", which first appeared in 1916, goes almost so far as is possible without the aid of the new mechanics and the refined vacuum methods developed afterwards in connexion with technical applications of thermionics. Richardson's "Electron Theory of Matter" is also well known to students of electricity and atomic physics, and although published between the advent of the Bohr and the Wilson-Sommerfeld theories of the atom and with a strong classical bias, is still much used. Richardson has made numerous important contributions to other branches of atomic physics, the most important of which are perhaps his extensive investigations of soft X-rays by electrical methods, and his unravelling of bands from the complicated molecular spectrum of hydrogen.

THE work for which the Duc de Broglie has been awarded the Nobel prize for physics for 1929 is of more recent date, and will be familiar to most readers of NATURE. Looking back now at his earlier work on the undulatory theory of matter, it would appear that the path of approach to the idea of the material wave was primarily from the realm of optics. de Broglie's important paper in the *Philosophical Magazine* for 1924 (vol. 47, p. 446) is entitled "A Tentative Theory of Light Quanta", and it is in this that he develops the analogy between the principles of Fermat and of Maupertuis, and shows how "the Lorentz-Einstein transformation joined with the quantum relation leads us necessarily to associate motion of body and propagation of wave, and that this idea gives a physical interpretation of Bohr's analytical stability conditions". The criticism which de Broglie anticipated would be accorded to these then novel

views has been constructive rather than otherwise, and it is by now an old story how his predictions have been verified by the experiments of G. P. Thomson, Rupp, Kikuchi, and others, and how his ideas have been elaborated by Schrödinger and incorporated in the present fabric of the quantum theory.

The Nobel prize for chemistry for 1929 has been divided between Prof. Arthur Harden, head of the Biochemical Department at the Lister Institute and professor of biochemistry in the University of London, and Prof. Hans von Euler-Chelpin of Stockholm. Prof. Harden, who is also one of the editors of the *Biochemical Journal* and an original member of the Biochemical Society, is perhaps best known for his work on the alcoholic fermentation of yeast: nearly twenty years ago he published a monograph on this subject, as one of the series of Monographs on Biochemistry, which has recently reached its third edition. He is the author (with W. J. Young) of papers on the co-ferment of yeast juice and the function of phosphates in the fermentation of glucose by yeast juice: from the latter observations has developed our knowledge of the place of hexose phosphates in carbohydrate metabolism, and it is now known that these substances play an important part not only in the yeast plant but also in higher animals as well, specially in the process of glycogen synthesis and breakdown, and hence in muscular contraction. Prof. Hans von Euler-Chelpin, who is professor of chemistry in the Technical High School, Stockholm, has also made noteworthy contributions to our knowledge of the chemistry of enzymes.

One hundred years ago—in 1829—the Royal Society made no conferment of its Copley medal, and doubtless at the time there was adequate reason. Originally, the small sum attaching to Sir Godfrey Copley's legacy was devoted to experiments for the Society's own advantage, but on Nov. 10, 1736, "Mr. Folkes proposed a Thought to render Sir Godfrey Copley's Donation for an Annual Experiment more beneficial than it is at present, which was to convert the value of it into a Medal, or other honorary prize, to be bestowed on the person whose experiment should be best approved: by which means he apprehended a laudable emulation might be excited among men of genius". The idea met with approval, and on Dec. 7 following, the president and council resolved "that instead of Sir Godfrey Copley's Annual Donation of Five Pounds, a Gold Medal should be struck of the same value, with the Arms of the Society impressed on it, and that the same should be given as a voluntary reward, or honorary favour, for the best Experiment produced within the year, and bestowed in such a manner as to avoid envy or disgust in rivalship". In 1756 the experiment provision was repealed, and there are now no time limitations, nor is the nationality of the recipient incidental to award. In 1766 triple awards of the medal were made, these respectively to William Brownrigg, Edward Delaval, and the Hon. Henry Cavendish. In 1840, Liebig and Sturm each received a medal, but since that date a single yearly allotment has been the rule.

As regards the two Royal medals, no intermittance occurred in 1829; the recipients were Charles Bell, and Eilhard Mitscherlich, of Berlin. The grounds of award for the former were "his Discoveries relating to the Nervous System"; for the latter, "his Discoveries relating to the Laws of Crystallization and the Properties of Crystals". Sir Charles Bell (he was knighted by William IV.) was born at Edinburgh in 1774. In early manhood he was already an anatomist of repute, and a convincing lecturer. His essay, "A New Idea of the Anatomy of the Brain" (1811), contained the discovery of the distinction between sensory and motor nerves. Bell died in 1842. Mitscherlich was born at Neuende (Oldenburg) in 1794, and died in 1863. Orientalist as well as chemist, he worked for some time with Berzelius at Stockholm, becoming afterwards professor of chemistry at the University of Berlin. His observation that corresponding phosphates and arsenates crystallise in the same form was the germ of the theory of isomorphism, communicated to the Berlin Academy, of which he was a member, in 1819.

The recent statement on the radium problem issued by the Radium Commission contains a much-needed warning against the exaggerated views on the possibilities of the therapeutic action of radium which have recently found expression in the daily Press. The problem presented by the treatment of cancer can only be properly understood by reference to the pathology of the disease. Cancer arises locally as a primary tumour. The primary tumour continues to grow locally and at the same time spreads, mainly through the lymphatic channels, to the neighbouring lymph glands. From there it spreads eventually to the more distant glands and to the internal organs, where the malignant cells grow as secondary deposits or metastases. Cancer can be cured with certainty in its earliest stage so long as it has remained a localised growth. It can then either be removed surgically or it can be destroyed by treatment with radium. Even when the malignant cells have begun to spread to the neighbouring glands, the cure is still possible if all the affected glands can be removed surgically or be subjected to treatment with radium. The recent advances in radiotherapy consist essentially in the fact that it has been possible to introduce radium, in the form of radium needles or of seeds containing radium emanation, into the growth and the surrounding tissues, so that a uniform irradiation of the growth and surrounding tissues can be ensured, and the malignant cells can be destroyed with certainty in the irradiated area.

The difference between surgery and radiotherapy consists therefore in principle in the manner in which the attempt is made to free the cancer patient from malignant cells. Surgery does so by removing the tissues containing the malignant cells; radium destroys them *in situ*. Both methods suffer from the difficulty that their application is limited by the accessibility of the organs which are likely to be affected. There is no evidence that the destruction by radium of the accessible malignant cells confers

upon the body the ability to rid itself of the malignant cells in the non-accessible site. In a word, radium is not a ' cure ' for cancer, but, like surgery, a treatment for cancer. As with all other treatments, its success depends upon the skill and knowledge of the operator and, what is most important, on the stage of the disease at which it is applied. Early diagnosis is as important for the successful treatment by radium as for the successful treatment by surgery. One great point in favour of radium is that its use does not involve the risks and suffering associated with extensive and mutilating operations. There is therefore a reasonable hope that, with prospects of a cure without mutilation, patients should be far more ready to consult their doctors at an early stage so as to ensure early diagnosis.

ON Friday, Nov. 15, Sir William Bragg opened an exhibition of historical scientific apparatus belonging to the Royal Institution, which for the time has been removed to the Science Museum, South Kensington, while the alterations in Albemarle Street are being carried out. The exhibition has been arranged by permission of the Board of Education and with the aid of the staff of the Museum, and it will remain open to the public during the winter months. Founded by Rumford in 1799, the Royal Institution has been the home, study, or laboratory of Rumford himself, Davy, Young, Brande, Faraday, Tyndall, De la Rue, Rayleigh, Dewar, and other eminent men of science, and much of the apparatus used in their experiments has been preserved. We understand that altogether there are some 1200 pieces of apparatus, and that about 250 of these have been placed on view in the gallery near the Exhibition Road entrance of the Museum. Much care has been taken with the labelling, and it may perhaps be suggested that many visitors would like to be able to procure a brief catalogue for future reference. In opening the collection, Sir William Bragg referred to some of the more important exhibits and paid an eloquent tribute to the work of Faraday and others.

THE exhibits are arranged chronologically, beginning with those of Rumford, who experimented on heat, and ending with some X-ray apparatus illustrating the work being done at the Royal Institution at the present time. Of the exhibits we may mention the electric batteries provided by the Royal Society for Davy, and Davy's and George Stephenson's miners' safety lamps. Of Faraday's apparatus there is the original sample of benzene which he separated for the first time in 1825, the world-famous iron ring with which in 1831 he discovered electromagnetic induction, objects illustrating his work on magnetism, compression tubes used for his experiments on the liquefaction of gases, and specimens of his own making showing the very beautiful sand figures formed under rippling water. Tyndall's work is recalled by the apparatus he used for the study of heat absorption by gases and vapours, his fifty-year old broths used for disproving the spontaneous generation of life, while Dewar's work is illustrated by a series of vacuum vessels, a liquid hydrogen calorimeter, a little gas thermometer, and his beautiful soap bubble apparatus. While referring to this exhibition, we think the attention of the Office of Works should be directed to the inadequate artificial lighting of some of the galleries of the Museum, rendering the close examination of the objects and the reading of the labels unnecessarily trying.

A NOVEL suggestion in connexion with the shearing of South African sheep has been made by Prof. A. F. Barker, professor of textile industries in the University of Leeds, as a result of his observations in South Africa during the recent meeting of the British Association. Prof. Barker suggests that, instead of letting the sheep grow a twelve months' (or even eight or ten months') fleece, thereby creating difficulties which the manufacturer may only be able partially to overcome, the wool should be sheared to manufacturing requirements, say from 1 in. to the maximum length of staple, just as required. The desirability of this procedure, he alleges, is confirmed by experimental work carried out at the University of Leeds, which indicates, *inter alia*, the value of equality of length of fibre and maximum length beyond which there is disadvantage rather than advantage. So far a summary only of Prof. Barker's report has been published, and his suggestion appears to be of limited academic interest. The British Wool Federation, the principal trade organisation of the raw wool industry, is inclined to view the suggestion with scepticism, for it writes that " the suggestion that a fleece which might grow to 8 in. long might be sheared in so many separate inches at various times of the year to the advantage of the farmer is beyond the comprehension of those who have been engaged in the Cape wool trade for many years past ".

ON Nov. 16 General Smuts delivered the third and last of his Rhodes Memorial Lectures at Oxford after receiving the honorary degree of D.C.L. in a special meeting of Convocation. The subject of the lecture was " Native Policy in Africa ", a subject which he described as part of the great question of colour and civilisation destined to become the dominant issue of the twentieth century. The lecture was an eloquent, yet at the same time closely reasoned, exposition of the policy of ' segregation ' in South Africa, which neither sought to minimise the mistakes of the past nor to pass over the difficulties which have to be faced in the near future. In both General Smuts finds lessons which may be a warning to the newer communities of other parts of Africa in finding a solution of their own native problems. The policy of segregation, which General Smuts traced back to the innovations of Cecil Rhodes in dealing with native affairs, contemplates, as is well known, the absolute separation of the white and native communities, the latter administering their own local affairs on their reservations.

As General Smuts pointed out, owing to the failure of both administrators and missionaries to appreciate the bearing of the results of the study of anthropology, instead of advancing the native they have helped to disintegrate native institutions and many steps had had to be retraced. Hence there are serious problems to be faced in South Africa to-day which other African

communities with this example in view may succeed in avoiding. Of these, one is the detribalised as well as the educated native to whom the policy of segregation cannot be made to apply—a source of both economic and political difficulty; and secondly, the question of representation of the native in the supreme legislature. An intense sympathy for native institutions and a desire to secure the advancement of the native along lines in harmony with his culture informed the whole of General Smuts' lecture. In years to come it will rank as one of the most important statements on native policy ever made by an Imperial statesman.

LORD BLEDISLOE'S offer to the nation in perpetuity of the Roman camp in his deer park at Lydney, Gloucestershire, is a public-spirited action which we hope will be appreciated at its full value, having in view the nature of the site. It will be remembered that the exploration of this camp was undertaken by the Society of Antiquaries and has been completed only recently. In certain respects, the site as a monument of antiquity is unique. It is a small hut-town standing on a commanding promontory jutting out from the Forest of Dean. Within its limits, it would appear to have been of some importance as a centre of iron-working and it includes within its boundaries the only iron mine yet found which can definitely be ascribed to the Roman period. According to an account in the *Times* of Nov. 15, the shaft of the mine is 1 ft. 6 in. to 2 feet wide and dips at an angle of 20°. It has been partly explored. On examination it was found that the surface of the rock still showed the marks made by the Roman miners.

THE main interest of the site, however, and the feature which makes its offer to the nation peculiarly welcome and appropriate, is the fact that we have here in this one area the evidence of a completed phase of British culture. The settlement begins with a civilisation still making use of bronze and showing affinities with Glastonbury and Meare, passes through a stage in which the native crafts give way to those of a Romano-British culture; and this in turn passes into a post-Roman phase in which the inhabitants sink back into a state of barbarism. One of the most interesting features of the site is the temple of Nodens, erected about 365 A.D., which, the evidence would suggest, was a great centre of healing. It may not be out of place to recall that Gloucestershire is one of the English counties rich in Holy Wells, which were at one time centres of healing, so that the cult of Nodens may perpetuate a still earlier cult. A debt of gratitude is due to Lord Bledisloe for an offer which will ensure the preservation of so interesting and important a site.

AT last a Committee has been appointed by the Government of Great Britain to consider whether it is desirable and feasible to create a national park. The attention of all concerned might profitably be directed to a 9-page pamphlet, issued as *Miscellaneous Publication*, No. 51, by the United States Department of Agriculture (September 1929). It gives a list of the national wild life reserves in the United States and indicates that the very argument which has been used against the creation of such areas in Great Britain, namely, the increase in population and the more intensive use of land, is just the argument which has led in America to the special protection of beasts and birds in reserves. Eighty-two areas, ranging in extent from rocky islets of 5 acres to the 2,000,000 acres of the Yellowstone Park, are administered by the Bureau of Biological Survey. They have been chosen primarily for their suitability for forms of wild life that have become greatly reduced in numbers or threatened with extinction. Some, even of great extent, are fenced for such large game animals as buffalo, antelope, mountain sheep, and wapiti. In addition to these areas, deliberately set apart as wild-life reservations, there are areas within national forests set aside for the protection especially of big-game animals; and wild life is given further protection in such places as national parks, national monuments, and lighthouse reservations, administered by other branches of the government for scenic, historical, or other special purposes. Surely here are hints in abundance for the creation of simple reserves in Great Britain.

WE have received from several correspondents comments on Mr. C. W. Marshall's letter on the magnetic reaction of the glowing filaments of carbon incandescent lamps which appeared in our issue of Nov. 9, p. 727, with a photograph giving an excellent impression of the visual appearance of the filament when vibrating. The phenomenon has been well known for at least forty years to electricians who are familiar with alternating currents. We agree with our correspondents in thinking that it can be satisfactorily explained by ordinary dynamical and electromagnetic principles. Forty years ago, Prof. Ayrton showed that if the wire of a monochord were of steel and carried an alternating current, and a magnet was brought close to the wire, small vibrations usually ensue. If, however, the weight be adjusted, we get a large vibration when resonance ensues. About a year afterwards, Dr. A. Russell varied this experiment by using an alternating current electromagnet, no current passing through the monochord wire. In this case, very large oscillations were obtained when resonance ensued. If l be the length of the wire in centimetres, m the mass of unit length of it in grams, and T be its tension in dynes, we have $f = \sqrt{T/m}/(4l)$, where f is the frequency, that is, the number of complete cycles of the alternating current.

THIS method of measuring frequency is well known in many electrical laboratories and is a very satisfactory one. The formula is deduced from ordinary dynamical and electrical principles. In the case of a glowing filament, whether of carbon or metal, having a few turns and carrying an alternating current, the helical part of the filament acts simply as an A.C. magnet, the polarity of the ends continually changing. Bringing up a permanent magnet produces repulsive and attractive forces on the filament and so it vibrates. We have often seen in an electrical laboratory a magnet brought near a coiled filament lamp, causing the filament to vibrate. Sometimes the vibrations are so large that the incandescent filament hits the glass

bulb, causing the glass in contact with it to melt and so letting in the air and burning out the lamp.

THE *Realist* generally contains good articles, but there is unusual suggestiveness for the biologist in Prof. Julian Huxley's analysis of the size of living things, which appeared in the September and October issues. In the earlier number are given some striking size contrasts, and a skeleton classification of organisms grouped according to size emphasises some curious relations. The largest of living organisms are the big trees of California ; the largest animals that have ever lived are whales. The smallest vertebrate is a frog—less than a queen bee, less than some of the Foraminifera. There are molluscs which belong to the same order of size as elephants, jelly-fish which rank with cattle and red deer. A diagram illustrating twenty-seven different organisms according to scale makes a series of vivid comparisons. The second article discusses the biological implications of size, and while it does not help to solve how animals attained their adjustments, it shows how the privileges and penalties of size have limited the course of evolution. Here also curious relations are brought out : the individual man is all but half-way between atom and star ; humanity entire stands in the same position between electron and universe.

WILLIAM FROUDE'S original experimental tank for model trials of ship's hulls, which he built at Chelston, near Torquay, has been followed by many larger and better equipped tanks, of which the latest is the Italian National Experimental Tank in Rome, the opening of which took place on Nov. 3. An illustrated article on this new tank appears in the *Engineer* for Nov. 15, where it is described as "noteworthy as being the best equipped and, from the point of view of its harmonious dimensions, probably the finest tank of its type in the world ". Constructed of reinforced concrete, the tank has a length of 275 m. (902 ft. 3 in.), a breadth of 12·5 m. (41 ft.), and a depth of 6·3 m. (20 ft. 7½ in.). The main carriage is designed for a maximum speed of 12 m. per second, and is adapted for testing hydroplane models as well as ship models and propellers. The model-shaping machine is designed to take a model 8 m. (26 ft. 3 in.) in length, and an interesting piece of apparatus designed by Dr. Gebers, the superintendent of the Vienna tank, is a measuring table furnished with micrometers in three directions, enabling the hull appendages, bilge keels, hull axis, and the propellers to be set in position on the hull with absolute accuracy.

THE provision of sufficient illumination is only a part of the problem of providing adequate lighting. Of equal importance is the avoidance of glare, a phenomenon which is familiar but not very easy to define. At a meeting of the Illuminating Engineering Society on Nov. 8, Mr. W. S. Stiles drew a distinction between ' disability glare ', which is manifested when a bright source in the field of vision impairs the ability of the eye to distinguish small contrasts, and ' discomfort ' glare, of which it is difficult to devise any ready test. Instructive experiments showing how the power of the eye to detect discs stencilled on a slightly darker background is affected by the presence of an unshielded electric lamp were performed. A demonstration of a method of evaluating glare based on the comparison of a lighting unit with a series of globes containing lamps of different candlepower was given. The intensity of glare is determined by a number of factors, such as the brightness (c.p. per sq. in.) of the source, its position in the field of view, its distance, and the nature of the background. Attempts have been made to express the influence of these factors by equations. Possibly, as was suggested in the discussion, glare is best regarded as due to excessive contrast in brightness. Early investigators considered that glare would be absent if the contrast in brightness of objects visible to the eye did not exceed 100:1, a condition that can be approached without undue difficulty in interiors, but seems almost impossible to realise in lighting streets and open spaces. What has long been needed is a simple test for determining quickly the degree of glare in an installation. Until this is available one is obliged to rely upon more or less empirical rules.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A visiting instructor of stained glass at the Central School of Arts and Crafts, Southampton Row, W.C.—The Education Officer (T.1), County Hall, Westminster Bridge, S.E.1 (Nov. 25). A lecturer in applied and pure mathematics in the University of St. Andrews—The Secretary and Registrar, The University, St. Andrews (Nov. 29). An assistant lecturer in the Department of Education of King's College, London—The Secretary, King's College, Strand, W.C.2 (Nov. 30). A lecturer in physiology in the University of Birmingham—The Secretary, The University, Birmingham (Dec. 3). A junior inspector under the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (Dec. 3). A lecture assistant in the Department of Physics of the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, W.C.2 (Dec. 6). An assistant lecturer in chemistry at University College, Southampton—The Registrar, University College, Southampton (Dec. 16). A resident tutor for chemistry and rural science (plant biology and gardening) at the Winchester Diocesan Training College—Rev. the Principal, Diocesan Training College, Winchester. A part-time teacher for evening classes in brickwork in the School of Architecture, Building, and Surveying, of the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1. A half-time assistant in the Department of Mathematics of the University College of Swansea—The Registrar, University College, Singleton Park, Swansea. Two junior researchers under the National Research Council of Canada for research work on, respectively, heat and aeronautics—The Secretary, National Research Council of Canada, Ottawa, Canada. An assistant chemist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Station, Waldegrave Road, Teddington.

Research Items.

Purification of Swimming Bath Water.—Reports appear from time to time suggesting that disease may be spread by swimming baths, and as the provision and use of swimming baths has increased greatly in recent years, the Ministry of Health has been well advised to institute an inquiry into the subject, the report of which has recently been issued ("The Purification of the Water of Swimming Baths." London: H.M. Stationery Office. Price 1*s.* net). When the water is infrequently changed, or is not subjected to purification, pollution must occur, chiefly from the persons of the bathers and from their costumes, and diseases may occasionally be transmitted, but there is no evidence to support the alarmist rumours that appear. Natural purification can be relied upon only when the pool is of considerable size, and the inflow of fresh water is sufficient. In smaller baths and pools, frequent change of water ('fill-and-empty system') is usually too costly, and some system of purification becomes necessary. For this purpose, filtration and aeration are useful, but some form of chlorination is to be preferred. Filtration with continuous chlorination is the method advocated, the chlorine being derived from bleaching powder, electrolytic fluids, chlorine gas, or chloramine. All these methods are described and discussed.

Human Chromosomes.—The number of chromosomes and the character of the sex chromosomes in man appear to be settled by a memoir of Prof. H. M. Evans and Dr. Olive Swezy (*Memoirs Univ. of California*, vol. 9, No. 1). The male germ cells from six individuals were studied, one of whom was a negro and one a Mexican. The number of 48 chromosomes was confirmed, and, in addition, the occurrence of an XY pair of sex chromosomes appears to be proved. Immediate fixation is a first essential in obtaining good material for study. The thread stages of the heterotypic mitosis were traced. The XY pair of chromosomes forms a pear-shaped chromatin nucleolus, and the chromatin threads pair laterally in the bouquet stage. Half the primary spermatocytes receive the Y-chromosome, which is the smallest of the chromosomes, and half receive the medium-sized X-chromosome. In the second meiotic division the Y-chromosome is shown to divide, the haploid number of chromosomes being 24. The chromosomes of young human embryos were also studied, a white embryo of 23 mm. length being male, since its 48 chromosomes included a Y, and a Japanese female embryo having no Y but presumably XX, since the X pair are not clearly distinguishable in size from certain other pairs. Sections from the uterus of a negress again showed the female complement of chromosomes, and sections of a carcinoma from the lip of a man showed the Y-chromosome in each cell. There was no indication of a range of chromosome numbers in cancer tissue when fixed immediately after removal. The majority of the cells had 48 chromosomes of the ordinary somatic type, but some enlarged cells were found with what appeared to be 48 tetrads. This finding should lead to a reinvestigation of the cytology of cancerous tissue. Another conclusion which the authors emphasise is that if chromosome-lengths from male and female cells are compared, the largest pair in the male is slightly longer than the largest in the female, both in embryonic and adult tissue. This is regarded as a secondary sexual difference resulting from the presence of the Y- instead of an X-chromosome.

'Mountain Beavers' of America.—Popular names could scarcely be more misleading than in the case of these tailless rodents belonging to the genus *Aplodontia*. They are not beavers, and they are scarcer in the mountains than in the lowlands; in Oregon they are known as 'boomers', but they do not boom; in other districts as 'whistlers', but they cannot whistle. They are herbivorous burrowers which frequent the Pacific coast region of southern British Columbia, Washington, Oregon, and northern California. In their natural haunts, in the seclusion of the forest, they do not interfere with human interests, but the clearing of lands and extension of farming have offered new food supplies, and the mountain beavers have increased in numbers to such an extent that in many localities they have become serious crop pests. Their fur is of no commercial value, and the control of their numbers in areas where they cause serious damage resolves itself into the most efficient methods of trapping and poisoning. These are discussed by Theo. H. Scheffer in *Farmers' Bulletin*, No. 1598, of U.S. Dept. of Agriculture (August 1929). Fortunately, there need be no campaign of extermination against these rodents, since they are harmless throughout a thousand miles of their coast range.

Zoogeography of Java.—There are many significant facts in Dr. K. W. Dammerman's account of the zoogeography of Java (*Treubia*, vol. 11, p. 1; 1929), which contains full lists of the species of mammals, birds, reptiles, amphibians, fresh-water fishes, and land and fresh-water mollusca, but we can refer here to only one general result. It is well known that there occur in Java a number of animals which are absent from Sumatra or Borneo, or even from the Malay Peninsula, but reappear in some remote part of the Asiatic continent. The ingenuity of zoologists has been taxed to explain this anomalous distribution. Wallace first invoked a Java-Siam land-bridge, and later the influence of the glacial period; others have raised an imaginary land-bridge by way of the lesser islands west of Sumatra. But a closer analysis of the facts shows that the remarkable resemblance to the fauna of distant regions is mainly exhibited amongst bats and birds, in a far less degree amongst reptiles, almost negligibly amongst amphibia, fresh-water fishes, and mollusca (in the last case in 8 out of 370 species). It is clear that the bats and birds may have moved unhindered by short stretches of sea, and of the other creatures, it is remarkable that the remote resemblance does not hold good for the animals most in need of land-bridges. The question is not one of land-bridges, but a biological problem concerned with the disappearance of certain creatures from the intermediate areas.

Aquarium Keeping.—Lieferung 271 of Prof. Emil Abderhalden's "Handbuch der biologischen Arbeitsmethoden", Abt. 9. Methoden der Erforschung der Leistungen des tierischen Organismus, Teil I. 2 Hälfte, Heft 6, consists of an elaborate treatise by Dr. Wilhelm Klingelhöffer describing in detail the technique of aquarium keeping: "Einrichtung von Zimmer- und Freiland Aquarium und Terrarien einschliesslich der Technik der Haltung und Zucht von Fischen, Reptilien und Amphibien, 1928". The making of an aquarium is first discussed, with details of all materials for construction; then the heating and aeration. Small jars and tanks for the room and large fresh- and salt-water aquaria are described, the Frankfurt aquarium being taken as a model. A large portion of the work is given up to the fresh-water aquarium—its management, chemical constituents of the water, and the interaction of its plants and animals, with a discussion on hydrogen ion con-

centration—the best weeds and the best animals to place in it. Diseases of the fishes are described, protozoan or bacterial, or those due to worms and crustacea, food and instructions for collecting it, snails and crustacea and their needs, and the breeding of fishes, both British and foreign. Much less space is devoted to sea-water aquaria, and this is almost entirely confined to the small kinds which can be placed practically anywhere. The advice given, however, is excellent and should be very helpful considering the many creatures which can now be successfully kept in sea-water aquaria far from the sea. The final part deals with amphibia and reptiles, and the rearing of these animals in captivity. Here the value of 'vita' glass and its varieties is shown, and there is an interesting chapter on those garden-like enclosures which may consist of aquaria, aviary, and vivaria, described as *Freilandanlagen*.

Copepods of the *Terra Nova* Expedition. — Mr. Farran's account of the *Terra Nova* copepods includes much that is of interest (British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. 8, No. 3. Crustacea. Part X. Copepoda. By G. P. Farran, British Museum (Natural History), 1929). Apart from the fact that he records 231 species, 18 of which are new, his notes on many well-known and widely distributed forms are of great value and help us much towards a knowledge of this important group of planktonic crustaceans. *Calanus finmarchicus* from the southern hemisphere differs from the normal north temperate form in its smaller size and reduced number of teeth on the first basals of the fifth leg. The author suggests that it may be a different race. *Metridia lucens* reaches to within the Antarctic Circle, *Oithona similis* is common in hauls made under the ice, occurring over the whole area traversed from New Zealand to the Ice Barrier, *O. plumifera* occurs almost everywhere, excluding the Antarctic Circle. *Acartia clausi*, here regarded as indistinguishable from the *A. aurifera* of Brady, is common off New Zealand, and one specimen was found close to the equator. *Paracalanus parvus* occurs all over the area traversed as far south as 43° 52′ S. All these are common forms in the northern seas. The large *Rhinocalanus gigas* Brady, which may measure as much as 8·7 mm., is separated by the author from the more widely distributed *R. nasutus*; he thus differs from T. Scott, who regards it merely as a variety of the latter species.

Length of Day and Plant Growth.—Great activity is evinced in this field of physiological research, in which the literature was recently reviewed for English workers by Redington (NATURE, July 20, 1929, p. 108). In the *Biologisches Centralblatt*, vol. 49, pp. 513-543, Prof. Maximow, of the Institute of Applied Botany, Leningrad, gives a further account of his experiments in this field. He regards the attack upon the physiological effects of the length of the period of illumination as just beginning, and anticipates that the results of such investigations may be of great value in throwing light upon the transition from the vegetative to reproductive phase in plants. At the Royal Horticultural Society's gardens and laboratories at Wisley, Mr. M. A. H. Tincker continues the experiments he commenced at Aberystwyth upon the same problem. He gives a report of the progress of this work in the *Journal of the Royal Horticultural Society*, vol. 54, part 2, September 1929.

Forests and Rainfall.—The influence of forests on climate and water supply in Kenya is the subject of a pamphlet by Mr. J. W. Nicholson (*Pamphlets*, No. 2, Forest Department, Nairobi). Mr. Nicholson discusses first the general problems of forest and rainfall, and refutes the view that forests can have little influence in promoting rain. Unfortunately, there are few statistics on which to base arguments, and most of the discussion on this problem rests on a weak foundation. Mr. Nicholson is, however, convinced, even though he does not always carry conviction to his readers, that forest growth in East Africa has a considerable influence on precipitation. He believes that in favourable circumstances, mountain forests can induce dew on deposition from mist up to at least 25 per cent of the total annual rainfall. Monsoon rain is increased by forests to the extent of about 3 per cent. Cyclonic rain is not affected, but this type of rain does not occur in Kenya. On the other hand, he is convinced that convectional rain is greatly increased by the presence of forests. In discussing the relation of forests to the flow of streams, Mr. Nicholson does not agree that the retention of forests has much effect on the water capacity of the red clays of volcanic origin which cover considerable areas. They are of great depths, and though the surface layers may lose in fertility, the water flow to the streams remains fairly constant when the forests are removed. It is rather for their effect on increasing rainfall that he would preserve the forests.

Contributions to Mycology.—Vol. 14, Pts. 3 and 4 of the *Transactions of the British Mycological Society*, contains a number of contributions of varied and often general interest. These include the address of the president for 1928, Dame Helen Gwynne-Vaughan, given at the Littlehampton foray, upon "Problems of Development in the Fungi". The relations of the fungi with other groups are considered, as also such general problems as alternation of generations and heterothallism in the group. Mr. Chippendale discusses the behaviour in culture of a fungus parasitic upon cotton (*Ascochyta Gossypii*.). The causal organism of a leaf rot of the carnation (*Heteropatella Dianthii*) is described by Mr. Buddin and Miss Wakefield, and of a leaf-spot of *Arctostaphylos Manzanita* (*Pleospora herbarum*) by Messrs. Briant and Martyn. Miss Cayley has some very interesting observations upon the life cycle of the Mycetozoan genus *Didymium*, several species having been successfully reared in culture upon synthetic solid media. The conjugation of the motile (swarm-spore) gametes has been followed under the microscope; in some cases these gametes have arisen in monosporous cultures, so that an earlier statement to the effect that the spores were unisexual are not confirmed. Mr. Mitra describes a *Phytophthora* disease of cotton seedlings and fruit-rot of guava, whilst Mr. Ashby continues his interesting observations upon the stimulation of oospore production in pure strains of this fungus genus, even when homothallic, by pairing them in culture with some entirely different species. Mr. Corner has two papers upon the development of the ascothecium and ascocarp in the Discomycetes, a contribution to a much neglected field of fungus morphology. Mr. Cartwright has a note upon the unusual appearance of two wood-inhabiting fungi, *Lenzites* and a *Pholiota*, when grown in pure culture.

Kelvin Effect at Low Temperatures.—*Communication* No. 196a from the University of Leyden gives an account of the measurements of the Kelvin effects at temperatures down to that of liquid hydrogen in pure copper, copper alloy with 0·37 per cent gold, and silver alloy with the same amount of gold, made by Messrs. G. Borelius, W. H. Keesom, and C. H. Johansson. The wires were about a millimetre in diameter and were attached to a copper block which was cooled by liquid

ydrogen. The change of temperature at the middle f the wire on reversing a current of 7·14 amp. hrough it was measured by a platinum resistance hermometer wound round the wire. The direct neasurements were checked by measurements of he electromotive forces in thermo-circuits of the opper-gold alloy with lead, copper, and the silver-old alloy. At room temperature the Kelvin effects re all positive and decrease as the temperature de-reases; in copper, very quickly, so that at − 140° C. t is zero and becomes negative, reaches its greatest egative value at − 170° C. and then rises rapidly. n the copper-gold alloy it reaches a minimum at − 120° C., then a maximum at − 230° C. In the silver-old alloy it has a minimum value nearly zero at − 180° C. In no case does the effect appear to pproach zero as the absolute zero of temperature is pproached, which it should do according to the Nernst heat theorem.

High Frequency Quartz Crystal Oscillators.—Every-one who has used a radio receiver for broadcast re-eption knows that the frequency of the carrier wave mitted by the transmitting station must be kept igorously constant if interference between it and ther stations is to be prevented. A very desirable ransmitting circuit from the point of view of sim-licity is to use a very selective one, that is, one which nly emits appreciable radiation at a definite frequency. This is the circuit commonly used, and its working depends on resonance between a condenser and an nductive coil. Mechanical systems, however, can ow be used with much higher selectivity and with great increase of the frequency stability. In the *Bell Laboratories Record* for October, F. R. Lack gives an instructive account of modern high frequency quartz-crystal oscillators. He points out that any mechanical system of three dimensions possesses a arge number of degrees of freedom. The crystalline nature of quartz, also, complicates the nature of its vibrations. The elastic constant in a given direction with respect to the axes of the crystal varies with the direction. As a result, in practice, a quartz plate has a large number of possible modes of vibration, some of them differing only by a few hundred cycles. It has been noticed that a change of temperature or a slight variation of the circuit to which the crystal s attached sometimes causes the crystal to jump from one of these modes of vibration to another. These difficulties have now been practically overcome, and crystals are being sold on a commercial basis. The vibrations utilised are those which take place n the direction of the thickness of the plate. The temperature coefficient of this type of vibration is ninety cycles in a million per degree Centigrade for crystals designed for frequencies of two million cycles per second. As telephone and radio requirements are becoming more rigorous every day, we expect hat the use of crystal oscillators will rapidly in-crease.

Radio Time Signals.—Mr. A. R. Hinks has written an excellent pamphlet describing wireless time signals, the third edition of which has just been published by the Royal Geographical Society. It is primarily in-tended for the use of surveyors, who as a rule are not trained radio operators, but nevertheless must know how to receive the time signals transmitted from many high-powered stations for their benefit. The methods of signalling in 1925 were very varied but now they are becoming standardised. The first signals sent from the Eiffel Tower were mainly sent by hand, but the actual time signals were sent by the observatory clock. The signals were next made entirely auto-matic, the contact maker being synchronised with the observatory clock. The international system with the familiar six dots of the broadcasting time signal is now very commonly used. The standard rhythmic system, suggested originally by the Royal Geographical Society, was adopted by the Inter-national Union of Astronomy and Astrophysics and brought into use in January 1926. The accuracy of these time signals depends on the accuracy of the controlling clock and on the constancy of the lag introduced by the relays in the circuit between the clock and the transmitting apparatus. In winter, in the principal time-keeping observatories, Greenwich, Edinburgh, Paris, Hamburg, and Washington, there may be periods of a week or longer without seeing a star. Hence there may be an appreciable error in the time before it can be controlled by observation. Even when all precautions are taken by the surveyor, the error may be a tenth of a second. Very useful data are given which will interest everyone who has a good radio receiving set.

A Link between Strychnine and Brucine.—The close relation between the alkaloids strychnine and brucine has long been recognised. It is known that the latter contains merely two methoxyl groups more than the former, but no definite experimental demonstration of the relationship of the substances has hitherto been available. A few months ago the degradation of brucine by treatment with chromic acid was described by Wieland and Münster, who obtained two acids of the formulæ $C_{16}H_{20}O_4N_2$ and $C_{17}H_{22}O_6N_2$ respectively, but were unable to obtain a similar product from strychnine. The work has now been completed by Hermann Leuchs, who has long studied in this field, and who, with F. Kröhnke, describes in the September number of the *Berichte* (vol. 62, p. 2176) the degradation of diaminostrychnine. This substance, which is obtained by treating strychnine with concentrated nitric acid and reducing the product with stannous chloride, is easily oxidised by chromic acid, and gives rise to an acid which is completely identical with the second of the above-mentioned acids prepared from brucine. This acid can thus be considered as an experimental link between the derivatives of the two alkaloids.

Adsorption of Gases.—The *Journal of the American Chemical Society* for September contains an interesting paper by Prof. K. F. Herzfeld on the subject of adsorption of gases on solids, with special reference to the theory of catalysis. Previous workers have concluded that, although unimolecular film formation is part of the mechanism of the processes, there are present ' active spots ' on the surfaces, perhaps places where metal (or other) atoms are raised above the rest of the surface, and thus in a position where their valency forces are less occupied with other atoms. In this way the decrease of heat of adsorption with increasing amount of gas adsorbed can be explained, since these ' active spots ' would be the first to be covered. Herzfeld points out, however, that the reverse effect is also known, namely, increase of heat of adsorption with amount of gas adsorbed, and he gives a detailed analysis of the effect for the case of the adsorption of a gas without permanent dipoles on the surface of a solid composed of oppositely charged ions, assuming that the effects will be similar on metals. The abnormal result would then follow from the interaction of dipoles induced in neighbouring molecules by electric forces. " The best explanation seems to be the formation of groups of adsorbed molecules sticking together ". Some assumptions made by Taylor and his associates in explaining adsorption catalysis are carefully considered and shown to lead to difficulties.

The Cult of the Sun.

AT a meeting of the Royal Anthropological Institute on Nov. 5, Mrs. Zelia Nuttall read a paper on "The Cult of the Sun at the Zenith in Ancient America".

Attention was first directed to the important fact that all the ancient centres of civilisation in America are situated within the tropical zone. In this the sun passes through the zenith of each latitude twice a year at noon, excepting at the tropical lines, which it approaches very slowly, and passes through the zenith at noon for 10 or 12 consecutive days at the solstices, appearing to linger there before slowly moving away.

When the sun passes the zenith, vertical objects, of course, cast no shadow. The high temperature caused by the vertical rays over a particular area causes an indraught producing an ascending current carrying up the warm moist air which, condensed in the higher regions of the atmosphere, falls as rain. It is a law of Nature that, subject to modifications according to situation near sea or mountain ranges, the rainy season of any place begins almost, if not immediately, after the sun has reached its zenith.

Authentic, documentary, and historical evidence presented establishes that throughout tropical America this phenomenon was observed by means of gnomons ranging from staffs, high poles, plain or carved columns and stelæ, conical structures and altars, and finally temples situated on high substructures. The ancient sun priests dated the commencement of the year from the moment the gnomon cast no shadow, and the phenomenon was interpreted as a 'descent' of the sun, to which prayers were addressed for rain which, of course, were effective.

A number of peculiar structures with vertical shafts have been found in temples, and also below ground, and it is obvious that such would have afforded a perfect means of registering not only the sun at the zenith, when its rays would fall into the chamber, but also the culmination of the moon and other celestial bodies, in particular of the Pleiades in November, which heralded the dry season and gave the signal for the lighting of the bonfires which were kept burning day and night in the temple courtyards for public convenience during the dry and cold season.

The native representations in painting and sculpture show the sun god descending head-foremost in human form, or as a bird or a combination of both, associated with the serpent, the symbol of rain. A head in a solar disc or a winged head were also employed as symbols, and the sun god armed, seated in the centre of a solar disc, is another common form.

Mention was made of the interesting fact that, at Mrs. Nuttall's suggestion, the observation of the shadowless pole has been officially revived as a school festival in Mexico as an educational factor and a link with the past. This year, for the first time since 1519, it was celebrated in a public square, witnessed by thousands of school children, some of whom danced and sang in the Aztec language in native costume to the accompaniment of drums and flutes of ancient form.

In conclusion, it was pointed out that the northernmost great ruins in Mexico, those of the Guinada in the State of Zacatecas, are situated on the Tropic of Cancer, where the sun would appear to make a prolonged annual visit, and that in precisely the same latitude in Africa lie the ruins of Kalahshu, and not far to the south of Der, the ancient name of which was "the city of the sun". The ruins of Zimbabwe are within three degrees of latitude to the north of the Tropic of Capricorn, and their conical structure and a chamber with a vertical shaft appear to testify that in the Old, as in the New World, the inhabitants of the intertropical region observed and celebrated the passage of the sun through the zenith which was followed by rain.

The Storage of Food.

THE Report of the Food Investigation Board for 1928 [1] again reveals the wide scope of the researches on the preservation and storage of food carried out under its auspices. During the year, Sir William Hardy retired from the chairmanship and was succeeded by Sir Joseph Broodbank: and Dr. F. F. Blackman and Dr. J. B. Orr succeeded Sir Richard Threlfall and the late Prof. T. B. Wood as members. The extension of the Low Temperature Research Station at Cambridge was well advanced at the end of the year, and the new fruit storage research station at East Malling had been commenced: it was also decided to set up a fish research station at Aberdeen. On the other hand, work on fish by-products was discontinued.

Conditioning of Beef.

An important research on the changes undergone by beef during storage and its effects upon the palatability and flavour of the meat has been carried out by T. Moran and E. C. Smith and published as a special report to the Board.[2] The following general procedure is recommended: after killing, the carcase should be carefully dressed and cooled for 1-2 days at 31°-33° F.; the meat is then hung as sides or quarters at 36°-38° F. for 10-12 days and finally stored for the 24 hours before sale at room temperature or at 40°-45° F. It is also necessary to rest the animal before slaughter if good quality meat is to be obtained.

The first change after death is the onset of rigor mortis, which consists of a gelation of the muscle plasma, causing hardening and loss of irritability, and a production of acid which causes contraction of the muscle, increase in opacity, and later the breakdown of the protein gel. In experiments on the rate of cooling of carcases, it was found that the temperature in the muscles increased for the first few hours after death, partly due to the conversion of glycogen into lactic acid and partly due to the changes in the physical state of the proteins. The later stage of resolution of rigor is relatively slow: it is brought about by autolysis, by the acidity of the tissues, and by bacterial action, and can be controlled to a considerable extent by the conditions of storage.

In following the changes in detail, it is necessary to consider separately each tissue of which the meat is composed. The state of the superficial connective tissue is largely responsible for the appearance of the meat: it readily takes up 80-100 per cent of its weight of water, and becomes white and opaque; this may occur from excessive swabbing on cleaning the carcase or from sweating on removal from cold store. On

[1] Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1928. Pp. vi+110. (London: H.M. Stationery Office, 1929.) 3s. 6d. net.

[2] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 36: Post-mortem Changes in Animal Tissues—The Conditioning or Ripening of Beef. By T. Moran and E. C. Smith. Pp. vii+64+8 plates. (London: H.M. Stationery Office, 1929.) 2s. net.

drying, the tissue loses its excess water and becomes translucent again ; but if frozen whilst swollen, the fibres become broken up and disorganised.

The fat becomes rancid on prolonged storage : the change can be followed by estimating the increase in free acids and the decrease in the iodine number. The state of the fat determines the period of storage, since the slightest taint of rancidity is undesirable, and this develops whilst the lean part of the meat is still improving in flavour.

Little alteration occurs in the proteins during storage after the resolution of rigor : in a short period of hanging, autolysis is negligible, there is no increase in the water which can be expressed from the muscle, and, except on exposed surfaces where methæmoglobin may be found, no change in the pigment.

As regards the carbohydrates, the effective changes are over within 3 days of slaughter : the lactic acid reaches its maximum of about 0·8 per cent and then remains unaltered throughout storage.

With ordinary cleanliness, bacterial contamination of the carcase is only slight, and experiment showed that increase in the bacterial content of meat hung for 17 days at 41° F. is negligible.

The experiments on the palatability of the stored beef were carried out at the Household Arts Department, King's College for Women, London, and at Messrs. J. Lyons and Co.'s laboratories. They showed that conditioning effects a marked improvement in palatability, particularly in respect of tenderness, but also of juiciness and texture, without any change in flavour. The improvement is more marked with coarse than with prime joints. A few experiments also indicated that freezing beef has no marked deleterious effect on its palatability.

Apart from the scientific aspects of the improvement of the meat supply, the demand of the public for good meat is an important factor to be considered, and it is to be hoped that the experimental grading and marking scheme for home-killed beef [3] will stimulate this demand by giving purchasers confidence that they can obtain exactly what they require.

Fruit and Vegetables.

The chemical changes occurring in apples stored at 12° and 1° C. have been further studied by D. Haynes and H. K. Archbold. The rate of loss of respirable material, sugar, acid, and residue (cell wall material) per unit of nitrogen (protoplasm) has been found to be characteristic of the variety. Storage life may be roughly divided into three periods : in the first, the starch is hydrolysed with a concomitant rise in sugar ; in the second, at 1° C., the total sugar and sucrose decrease, but the reducing sugar rises slowly to a maximum ; in other words, the rate of inversion of sucrose is greater than the rate of consumption of its products ; in the third, at 1° C., internal breakdown has set in and the rate of loss of sugar is increased ; at this point the sucrose has all been inverted and the stable reducing sugars stored in the vacuole are oxidised. Throughout, acid is lost, the rate in the first and third periods being faster than in the second. At 12° C. internal breakdown does not occur but is replaced by senescence, which is observed at an earlier period of storage life and is characterised by very similar changes in the constituents of the fruit.

Fungal invasion of stored apples has been studied by A. S. Horne : a close relationship between the chemical composition of the fruit and susceptibility to invasion has been found ; thus decrease in the amount of acid is associated with an increase in the rate of invasion. The relationship between growth of fungi and the environment, especially the humidity, has also been studied by R. G. Tomkins.

The possibility of the cold storage of vegetables has been investigated by J. Barker : the commoner vegetables can be stored for a few weeks at 45° or 33° F. The lower temperature is the more satisfactory, except for potatoes, which sweeten near the freezing-point. Even lower temperatures, 26° and 29° F., at which partial freezing occurs, are satisfactory for cabbages, cauliflowers, or sprouts, but not for tomatoes, cucumbers, or lettuces. Preliminary experiments on the rate of deterioration after removal from cold store indicated that 33° F. was more suitable than 45° F., except for tomatoes.

These excerpts must suffice to indicate the nature of some of the work which has been carried out under the direction of the Board. Among other subjects dealt with are corrosion of metal food-containers, with the production of hydrogen and perforation of the can, the transport of butter in insulated vans, and the freezing of fish on board the trawler so that it can be kept for a longer time and landed in a fresher condition. The report also refers to work on the control of temperature and humidity and on methods of refrigeration.

[3] Home-killed Beef : Experimental Grading and Marking Scheme. Ministry of Agriculture and Fisheries. Marketing Leaflet, Nos. 13 and 13*a*.

Nickel in Engineering.

IN a lecture on "Nickel and its Uses in Engineering", delivered before the Junior Institution of Engineers on Nov. 15, Mr. W. T. Griffiths stated that, prior to the War, 65 per cent of the world's production of nickel was utilised in the manufacture of nickel steel for armament purposes ; after the Armistice, production dropped to the level of the years 1890–91.

New uses for nickel have now increased the consumption to as high a figure as any attained during the War. A considerable portion of the output is used, on account of its high melting-point, in the radio electrical industry for parts of wireless valves ; it is also used for the electrodes of sparking plugs. In chemical engineering much use is made of it on account of its ability to withstand alkaline reagents. In mechanical engineering it is largely used by means of electro deposition for building up worn parts of mechanisms, but its principal uses are found when alloyed with other metals ; for example, in steels it increases toughness, and in conjunction with heat treatment much improves the homogeneity of castings; in case-hardened articles it increases the penetration of the hardening material, and in many cases eliminates a preliminary heating and quenching ; in conjunction with chromium and molybdenum, large forgings can be made as the elastic limit of the material is much improved. In Canada, nickel alloy steel is used in casting the bar framing of locomotives and even in boiler parts including plates, firebox and tubes being made of an alloy steel containing 2 per cent of nickel, thus enabling the boiler pressure to be increased by some 37 per cent without increasing the weight of the engine.

When alloyed with iron, nickel has the property when present to the extent of about 25 per cent of destroying the magnetic properties of iron, but a higher percentage of nickel restores these properties, and the Western Electric Co. of America has established that after heat treatment of high content nickel-iron alloys, the magnetic qualities are 10-13 times better than the best soft iron ; it also has much effect in diminishing the hysteresis loss. These properties are

of much use in submarine cables where great permeability is desirable to ensure quick working. The alloy is insulated from but wound round the copper conductor and prevents the interference of stray currents. An alloy of 35 per cent nickel, 35 per cent cobalt and iron, known as perminvar, shows great constancy of permeability. In heat-resisting steels, it prevents corrosion of the steel up to temperatures of 600°-700° C. Nickel chromium alloys are now largely used for electrical heating purposes, ribbons of the alloy arranged along the top and sides providing the heating elements in large annealing furnaces.

Nickel alloyed with copper increases the tensile strength of the latter from 21 tons to 45 tons per square inch. It is now greatly used for condenser tubes, these as compared with brass having a long life without corrosion.

In the discussion following the paper, it was stated that nearly all the nickel used in the world comes from within the Empire, Canada producing 90 per cent of it; there are also small deposits in New Caledonia.

University and Educational Intelligence.

BIRMINGHAM.—On Nov. 13 the new Mining Machinery Laboratory was opened by Mr. Evan Williams, president of the Mining Association of Great Britain. The object of the laboratory is to enable students of mining to get first-hand knowledge of the construction and mechanism of the latest coal-mining machinery, which will be supplementary to the knowledge of the operation of coal-cutting and conveying, which can only be learnt underground. The Miners' Welfare Fund has found the money for the building, and the machinery for equipment has been presented by the manufacturers themselves, no fewer than twenty-two firms having contributed of their products. The opening of this laboratory marks a further step in the policy of the Mining Department, which is to help the coal industry to regain its prosperity by providing it with trained public school and university men who, after acquiring experience underground, should be capable of contributing to the solution of some of the many problems with which the industry is confronted.

CAMBRIDGE.—Mr. D. Portway, St. Catharine's College, has been appointed University lecturer, and Mr. G. S. Gough, Pembroke College, University demonstrator in the Faculty of Engineering.

Dr. E. K. Rideal has been appointed a member of the Board of Research Studies.

MANCHESTER.—Prof. F. E. Weiss will retire at the end of the present session from the George Harrison chair of botany and the directorship of the Botanical Laboratory. He has held these appointments since 1892.

IT it announced in the Report of the governing body of the School of Oriental Studies of the University of London that a lectureship in Iranian studies has been founded in the School. The funds for the foundation have been provided for a period of five years by the Parsee community of Bombay. This is not the first occasion on which humane and historical studies in Great Britain have been indebted to the public spirit and munificence of the Parsee community in India, and there can be little doubt that when the first period of five years has elapsed it will once more come forward to meet an increasing need. For, as the report points out, this chair is the only provision in Britain for this important branch of Oriental studies. In fact, the great increase in the study of Sanskrit and Indian history has necessitated the institution of two new lectureships in these departments.

Calendar of Patent Records.

November 23, 1848.—The idea of perforating sheets of postage stamps was due to Henry Archer, who devised a machine for "cutting or stamping around the margin of every stamp a consecutive series of holes whereby the tearing up of the sheet will be greatly facilitated," and obtained an English patent for his invention on Nov. 23, 1848.

November 24, 1854.—In a patent granted to him on Nov. 24, 1854, Sir Henry Bessemer proposed to give rotation to a projectile when fired from a smooth-bore gun by allowing a portion of the powder gas to escape through passages formed in the projectile and terminating in the direction of a tangent to its circumference. The tangential emission of gas would then act as a turbine and produce a rapid rotatory motion of the projectile. The British military authorities refused to undertake tests of the invention, but Bessemer carried out successful experiments in his own grounds near Highgate and afterwards at Vincennes before the Emperor Napoleon III. It was the necessity of increasing the strength of the guns to enable them to withstand the resulting pressures that led Bessemer to the serious study of the metallurgy of iron.

November 24, 1874.—The earliest proposal for a barbed-wire fencing was made in the United States in 1867, but the most important patent was that granted to Joseph F. Glidden on Nov. 24, 1874, on an application made on October of the previous year. Glidden's application was challenged by Jacob Haish, another prominent inventor of a barbed wire, but the United States patent office decided in favour of Glidden, and it is mainly on his invention that the industry was established. Patent litigation between the rival interests was continuous from 1874 until 1892.

November 25, 1802.—William Dobson was granted a patent on Nov. 25, 1802, for his "new invented method never before applied for that purpose of chasing away flies and venemous insects, and calculated to promote the free circulation of air in rooms". The invention comprised a clockwork-driven fan mounted on a telescopic standard or pendant. The 'Zephyr', as it was called, was adopted by many large houses in Great Britain and abroad.

November 26, 1822.—Joseph Egg, a London gun-maker, who, on Nov. 26, 1822, was granted a patent for improvements in fire-arms "upon the self-priming and detonating principle", is one of the claimants to the invention of the copper percussion-cap. He appears to have been the first to manufacture such caps, but it was stated a few years later that he obtained the idea of the cap indirectly from Joshua Shaw, who probably has a better right to be called the actual inventor.

November 29, 1879.—The early multiple switchboards for telephone exchanges did not completely fulfil their function, because satisfactory means had not been devised whereby any operator could instantly ascertain whether a particular subscriber's line was already engaged by another operator. The first to incorporate a practical 'test' apparatus of this kind in a telephone switchboard was the American, C. E. Scribner, who was granted a British patent on Nov. 29, 1879, for his invention. The earliest known proposal for a switchboard for the purpose of intercommunication between individual subscribers at their own request was made in connexion with the telegraph system, and was patented by François Dumont in France in 1850, also in the month of November, and in England a few months later. A few installations of this character came into use.

Societies and Academies.

LONDON.

Royal Society, Nov. 14.—V. Henri and O. R. Howell: The structure and activation of the molecule of phosgene. An analysis of the ultra-violet absorption spectrum of phosgene vapour. The spectrum, about 270 bands between 3050 A. and 2380 A., has been photographed at pressures from 0·1 mm. up to 680 mm. and analysed. The absorption region is therefore the same as for all substances containing the CO group, but whereas with aldehydes and ketones the absorption reaches a maximum at about 2800 A., with phosgene it increases continuously towards the ultra-violet. The spectrum is purely vibrational. The bands consist of doublets with a separation of 0·5-1 A., and of singlets distributed at regular intervals in the spectrum. As an aid to elucidating the ultra-violet spectrum, the Raman spectrum of phosgene was also obtained.—T. M. Lowry and C. B. Allsopp: A photographic method of measuring refractive indices. A film of liquid is formed between the half-platinised plates of a quartz etalon, illuminated with multi-chromatic light from a metallic arc, and the interference bands formed in the film focused on the slit of a spectrograph. After calibrating the instrument with an air film, the refractive index of the liquid is deduced from the number of ripples between two fixed points on the slit of the spectrograph.—C. P. Snow and E. K. Rideal: Infra-red investigations of molecular structure (3 and 4). The vibration-rotation band ($n'' = \frac{1}{2} \rightarrow n' = \frac{3}{2}$) of CO has been resolved completely. The general character of vibration-rotation bands carried by ^1S molecules is discussed, and the CO bands are shown to be consistent with the scheme. A theoretical discussion includes constants of potential functions and description of band lines.—P. M. S. Blackett, P. S. H. Henry, and E. K. Rideal: A flow method for comparing the specific heats of gases. A slow stream of gas passes through an electrically heated iron tube, to which are attached constantan wires, in such a way as to measure temperature difference between two points symmetrically placed on tube. Temperature distribution along the tube alters slightly, and, under certain conditions, measured temperature change is a direct measure of specific heat of gas.—J. H. Brinkworth: On the temperature variation of the specific heats of hydrogen and nitrogen. Specific heats of nitrogen can be calculated to an accuracy of 1 in 500, at 60°-1200° K., using Callendar's characteristic gas equation. With a modified Planck-Einstein formula for rotational specific heat, hydrogen values agree extremely well with experiment below 600° K.; at 1000° K. they are high, but there is excellent agreement at 1200°-1600° K. Moments of inertia of molecules of hydrogen and nitrogen are deduced.—R. W. Lunt and M. A. Govinda Rau: The variation of the dielectric constants of some organic liquids with frequency in the range 1 to 10^3 kilocycles. There is no variation for benzene, ether, or chloroform, but a slight increase for methylated ether, ethyl alcohol, acetone, aniline, and nitrobenzene takes place in the range 10^2-10^3 kc. In this range the conductivity of aniline diminishes rapidly as the frequency is increased, that of nitrobenzene diminishes slightly, whilst that of ethyl alcohol and of acetone does not vary.—J. A. Hall: The international temperature scale between 0° and 100° C. An extensive intercomparison between the platinum-resistance thermometer and a number of mercury in *verre dur* thermometers, standardised by the Bureau International des Poids et Mesures, shows that the change from the latter to the former as the standard of the National Physical Laboratory, will not alter the temperature scale used by that institution by more than 0·002° C. between 0° and 50° C. or 0·005° C. between 50° and 100° C. Differences between scale defined by platinum thermometer and thermodynamic scale probably do not exceed a few thousandths of a degree between 0° and 50° C., or 0·01° C. between 50° and 100° C.—D. M. Murray-Rust and Sir Harold Hartley: The dissociation of acids in methyl and ethyl alcohol. In methyl and ethyl alcohols, HCl, $HClO_4$, $HClO_3$, $HEtSO_4$, $HSO_3C_6H_5$ are strong electrolytes, while HNO_3, HCNS, HIO_3 are weak acids. From measurements with hydrogen chloride, the mobility of the hydrion is calculated to be 142 in methyl, and 59·5 in ethyl alcohol. Addition of small quantities of water to solutions of acids in alcohol causes large decrease of conductivity of the strong acids and correspondingly large increase in case of weak acids, and can be used as a qualitative test for the two classes.—K. S. Krishnan: The influence of molecular form and anisotropy on the refractivity and dielectric behaviour of liquids. The theory of the optical and electrical properties of liquids outlined by Raman and Krishnan is applied to the case of benzene for which the necessary data are available. The change in the Lorentz refraction 'constant' in passing from vapour to liquid, and the effect of temperature and pressure variations on the 'constant' are successfully evaluated numerically. The application of the theory to the dielectric behaviour of liquid benzene is equally successful.

Linnean Society, Nov. 7.—Dr. Hugh Scott: A natural history excursion into Basutoland. Deforestation and destruction of big game have been extensive. Almost the only native 'timber' seen was scrub composed of a Rosaceous bush, *Leucosidea sericea*, 5-15 ft. high. All arable land is devoted to cultivation of mealies (maize) and Kafir corn (*Sorghum*), and the grassy slopes are stocked with horses and cattle. Entomological collecting resolves itself largely into 'sweeping' grass and flowers, searching under stones and working the low dense bush of kloofs. The insects obtained, about a thousand specimens, are being dealt with at the British Museum. A species of cockroach was observed to display maternal care for its young, a fact of considerable biological interest. —G. E. Nicholls: A new Syncaridan from the west coast of Tasmania. This small freshwater crustacean was first taken by the author in February 1928 in a sphagnum-choked ditch near Queenstown. It is the third member of the sub-order Anaspidacea to be discovered in Tasmania, and seems most closely related to *Koonunga cursor*, at present known only from the Australian mainland. It is less than one-third of an inch in length, colourless and almost transparent. The mature animal is conspicuous by its golden or orange-coloured gonads, and in these specimens a chocolate-brown pigment is developed irregularly upon the dorsal surface.

EDINBURGH.

Royal Society, Nov. 4.—Frances M. Ballantyne: Notes on the development of *Callichthys littoralis*. A description of the embryonic and larval stages of this armoured Siluroid. After giving a general account of the ontogeny of the fish, the development and the adult form of the skull and chondrocranium, of the fins and external skeleton, and of the various organs, are described in some detail. Particular attention is directed to the air-sacs at either side of the head, and their relationship with the otocyst, and it is shown that they develop from a transient air-bladder.

These very specialised fish have some primitive characters reminiscent of *Polypterus* and the Dipnoi. The resemblance to *Polypterus* is specially marked in the development of the paired fins and in some of the modifications of the venous blood-system, while another primitive feature is shown in the platybasic chondrocranium where the trabeculæ are continuous with the parachordals. The facts of development, however, clearly show that the Siluridæ are rightly placed among the Teleostei.—**A. W. Greenwood**: Some observations on the thymus gland in the fowl. The examination of thymus weights in normal, castrated, and gonad engrafted fowls showed that in normal adult fowls the thymus is larger in the male than in the female. Castration and ovariotomy delay or decrease the rate of thymus involution. Whereas successful implantation of testis into complete males has no effect on the thymus, successful implantation of ovary causes a degree of thymus involution comparable with that in the female.—**B. P. Wiesner**: On the mechanism of the diphasic sex cycle. The periodic appearance of the œstrous cycle is due to periodic secretion of the ovary. There exists periods of refractory behaviour in the ovarian response to anterior lobe. The anterior lobe itself works periodically in two phases: the first phase incites the first phase of ovarian secretion (œstrous hormone) through an œstrogenic substance (Rho 1); the second phase incites beta production in the ovary through a 'kuogenic' substance (Rho 2). Methods are described for the separation of Rho 2, which is more resistant to heat than Rho 1, and the specific test for it (mucification) is discussed.—**L. Mirskaja**: On the presence of a kuogenic substance in the mouse placenta. The placenta, when implanted in the immature mouse, creates conditions of pseudo-pregnancy, and never induces œstrus. Since it is without effect in the ovariectomised female, it is assumed that it contains a kuogenic substance equivalent to Rho 2 from the anterior lobe.—**A. C. Fraser** and **B. P. Wiesner**: Variations of the rest metabolism of the rat in relation to the sex cycle. Varies considerably in relation to the œstrous cycle. A relatively high maximum is reached shortly after heat.—**H. W. Turnbull** and **J. Williamson**: Further invariant theory of two quadratics in n variables. The paper materially simplifies an original argument used twenty years ago, which was the basis of a paper published by the Society in 1925.

PARIS.

Academy of Sciences, Oct. 14.—**Marin Molliard**: Two new examples of morphological characters depending upon external conditions. The abnormal development of hair in a pea pod can be produced by partially exposing the internal epidermis of the pod to the air. The second case was the experimental production of red stripes in the petals of the white opium poppy by prematurely opening the buds and separating the two sepals.—**Léon Guillet** and **Ballay**: The corrosion of aluminium alloys in superheated steam. The experiments were carried out on the purest aluminium obtainable (99·87 per cent), three samples of ordinary commercial aluminium, an alloy with 8 per cent copper, duralmin, and alpax. The purest metal was completely destroyed; alpax was the most resistant to the steam. It is probable that the corrosion in steam is a function, not only of the chemical composition, but also of the structure and previous thermal and mechanical treatment of the alloy.—**Herbrand**: The fundamental problem of mathematics.—**J. A. Lappo-Danilevski**. The generalisation of the formula of Jacobi concerning the determinant formed from solutions of a system of linear differential equations.—**A. Andronow**: The limit cycles of Poincaré and the theory of self-maintained oscillations.—**A. Tsortsis**: A method of integration of Monge's equations.—**Victor Vâlcovici**: The generalisation of the theorem of moments of quantities of motion.—**N. Théodoresco**: A formula generalising Cauchy's integral and on the equations of plane elasticity.—**André Argand**: Concerning the study of the plane irrotational movement of incompressible fluids in the steady state.—**Marcel Prot**: The calculation of railway sleepers of reinforced concrete.—**William Loth**: The magnetic guidance of airships; safety aerodromes. Description of improvements on the method described in 1921 and 1922 for guiding aeroplanes or airships to an aerodrome under conditions of bad visibility.—**Maurice Lambrey**: The absorption spectra of nitric oxide.—**P. Chevenard**: The limit of the solubility of copper in the reversible ferro-nickels. An application of the dilatometric method to the study of the diagram iron-γ-nickel-copper.—**Paul Remy-Cenneté**: The dissociation of calcium hydride, CaH_2. Previous work on this subject has given discordant results; some workers have found normal dissociation phenomena, others suppose that the hydride and the metal form a continuous series of solid solutions, and that the pressures found are a function of the calcium in excess. In the present experiments, the distillation of the calcium is prevented by enclosing it in a sealed iron tube, advantage being taken of the fact that at high temperatures iron allows hydrogen to pass through, but not calcium vapour. It has been established that the pressure is a function of the temperature only and is independent of the proportion of calcium present.—**B. Bogitch**: The oxidation and reduction of the iron silicates by gases. A blue silicate exists corresponding to a lower oxide of iron which alone is stable in the presence of metallic iron at high temperatures. This lower oxide is nearly always accompanied by FeO.—**Maurice François**: Study of the dissociation of the compounds $HgBr_2 . 2NH_3$ and $HgCl_2 . 2NH_3$. These compounds are molecular combinations analogous with Isambert's ammoniacal silver chloride.—**A. Pereira Forjaz**: Contribution to the study of the Müntz methods of nitrification. In the biochemistry of the fixation of atmospheric nitrogen it is possible that mineral catalysts may intervene; experiments with *Cytisus proliferus*, var. *palmensis* using a spectroscopic method showed that in this case the specific elements of biocatalysis were molybdenum, nickel, and cobalt.—**L. Mercier**: The chetotaxy of the wing of *Limosina pusilla*, from the point of view of secondary sexual characters.—**Brocq-Rousseu, Mme. Z. Gruzewska**, and **G. Roussel**: The influence of the ionic concentration of the medium on the activity of the amylase of horse serum. Whatever number of successive bleedings may be carried out, amylase and maltase are always found in the serum. Diagrams are given showing the relation between the sugar present and the number of bleedings.—**Paul Génaud**: The ion exchanges between yeast cells and solutions of lead nitrate.—**A. Policard, S. Doubrow**, and **M. Boucharlat**: The mechanism of pulmonary silicosis. The influence on cells cultivated *in vitro* of silica dusts arising from working on the rock in coal mines. Gye and Kettle, in their studies on silicosis, and Mavrogordato, in experiments on the effects of dust inhalation, have attributed this action to the slow solubility of silica in the slightly alkaline tissues. The experimental facts cited tend to confirm the view that regards the origin of the troubles of pulmonary silicosis as due to a slow toxic action of slowly dissolved silica.—**Georges Blanc** and **J. Caminopetros**: Some experimental data

n the virus of dengue. The experiments described how that the virus of dengue and that of yellow ever are distinct.

VIENNA.

Academy of Sciences, July 11.—E. Gebauer-Fülnegg nd E. Riess: The course of oxidation in aryl-sulpho-rylides.—E. Reiss and R. Feiks: The action of romatic sulpho-chlorides on β-amino-anthraquinone. —E. Blumenstock-Halward and E. Riess: Note on rimercapto-β-naphthol.—M. Samec: Sulphurylisa-ion of starch.—E. Abel and E. Neusser: The vapour ressure of nitrous acid.—O. Redlich: The molecular tate of water.—F. Böck and G. Lock: The determina-ion of hydroquinone and pyrocatechin in the presence f other phenols (1).—K. Beaucourt: The constituents f resin (1). The boswellinic acid from olibanum ncense resin).—F. Pollak: The kinetics of the reac-ion between bromic acid and hydrobromic acid.—. Schwarz: A simple micro-method for determining olecular weights. Depends on isothermic distilla-ion.—G. Koller and E. Krakauer: The constitution f cetraric acid, $C_{20}H_{18}O_9$, obtained from an Icelandic chen.—G. Koller and E. Strang: Some derivatives f 6, 7-benzo-1, 8-naphthyridine.—W. Leithe: The atural rotation of polarised light by optically active ases (4). The rotation of some synthetic isoquinoline erivatives.—H. Holter and H. Bretschneider: Re-earches on the possibility of the formation of tetrazo-ethane, CN_4.—G. Burger: The separation of alkalis n minerals with the interferometer. A possible ravimetric determination of potassium and sodium y an optical method.—A. Friedrich and A. Salzberger: n lignin (5). The connexion between lignin and esin. The resin in spruce wood differs from the resin btained from wounds of this tree, the resin extracted rom the wood containing methoxyl groups. There s one sort of lignin dissolved in the wood-resin and nother lignin in contact with cellulose.—H. Mache: pecific heat on the lines of equal internal energy and f equal heat content.—J. Kisser: Analysis of the esults of chemical stimuli in seed germination. Pre-minary inquiries with quickly germinating seeds. ccess of oxygen is of great importance.—J. Kisser nd S. Possnig: Researches on the influence of im-eded and promoted oxygen respiration on seed ermination and seed growth. Oxygen helps; the eed-coat of *Pisum* hinders access of oxygen, hydrogen eroxide penetrates the seed-shell.—J. Kisser and R. tasser: Researches on the bending of roots and hypo-otyls of shelled seeds of Leguminosæ. The seed-coat dheres to the radicle, hence removal of this part of he coat may injure the radicle.—J. Kisser and R. Vindischbauer: Researches on the permeability of he seed coats of *Pisum sativum* for water and gases. Hydrogen peroxide delays the swelling, but stimulates ermination. Weak solutions of sodium and man-anese chlorides promote swelling of the seed-coat. ir-dry seed-coats permit the passage of gases with ifficulty.—S. Meyer: Physical foundations for adium emanation therapy. Radium emanation bsorbed by the human body is in preponderating easure lost again by breathing.—E. Kara-Michailova nd B. Karlik: The relative brightness of scintilla-ons of H-rays of different range. The α-particles se energy in penetrating a crystal layer, and the rightness corresponds to the energy lost. Effects epend on the size of the crystals and the thickness f the zinc sulphide layer.—K. Fritsch: *Camelina melica*. A variable plant.—E. Müller and W. Loer-abel: The catalytic decomposition of aqueous solu-ons of formic acid by the platinum metals (4).—R. chumann: Vectorial adjustment of a measured iangle.

Official Publications Received.

BRITISH.

Transactions of the Institution of Chemical Engineers. Vol. 6, 1928. Pp. 202. (London.)

Commonwealth of Australia: Bureau of Meteorology. Results of Rainfall Observations made in Western Australia, including all available Annual Rainfall Totals from 1374 Stations for all Years of Record up to 1927, with Maps and Diagrams; and Record of Notable Meteorological Events; also Appendices, presenting Monthly and Yearly Meteorological Elements of Perth, Broome and Kalgoorlie. Pp. xiv+387. (Melbourne: H. J. Green.)

Studies from the Connaught Laboratories, University of Toronto. Vol. 3, 1926–1928. Pp. vii+331. (Toronto: University of Toronto Press.)

Department of the Interior, Canada. Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 1, January, February, March 1929. By Ernest A. Hodgson. Pp. 17. (Ottawa: F. A. Acland.)

Records of the Geological Survey of India. Vol. 62, Part 2. Pp. 187-291+9 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Proceedings of the Sixteenth Indian Science Congress, Madras, 1929. (Third Circuit.) Pp. xxxiv+474. (Calcutta: Asiatic Society of Bengal.)

Home Office. Report on Conferences between Employers, Operatives and Inspectors concerning Fencing of Machinery, First Aid and other Safeguards in Cotton Weaving Factories. By Eliot F. May. Pp. 21. (London: H.M. Stationery Office.) 3d. net.

FOREIGN.

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 2: Petroglyphs of California and adjoining States. By Julian H. Steward. Pp. 47-238+plates 22-94. 2.50 dollars. Vol. 24, No. 3: Yokuts and Western Mono Pottery-making. By A. H. Gayton. Pp. 239-252+plates 95-102. 40 cents. Vol. 25, No. 4: Archaeology of the Northern San Joaquin Valley. By W. Egbert Schenck and Elmer J. Dawson. Pp. 289-413+plates 74-102. 1.55 dollars. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

Conseil International de Recherches, Union Géodésique et Géophysique Internationale: Section d'Océanographie. Bulletin N. 12: Bibliographie des Marées (1910–1927). By Prof. J. Proudman. Pp. 27. (Venezia.)

Recueil des Travaux Chimiques des Pays-Bas. Publié par la Société Chimique Néerlandaise. Tome 48, No. 9. Pp. 797-1074+ii. (Amsterdam: D. B. Centen.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Tome 2: Annuaire pour l'an 1930. Rédigé par V. V. Michkovitch. Pp. 133. (Belgrade.)

CATALOGUES.

High-Tension Transformers for the Production of X-Rays. (Bulletin W.) Pp. 48. (London: Watson and Sons (Electro-Medical) Ltd.)

Chemische, chemisch-technische und physikalische Zeitschriften. (Jahrg. 8, Nr. 4, November.) Pp. 16. (Berlin: Verlag Chemie, G.m.b.H.)

Catalogue of Important, and in many cases, Rare Books in various Branches of Natural History. (No. 172.) Pp. 96. (London: Dulau and Co., Ltd.)

Medical Books, New and Second-hand. (Catalogue of Dept. No. 9, November.) Pp. 44. (London: W. and G. Foyle, Ltd.)

The Bureau of Information on Nickel. Nickel Steel, Series A, Paper No. 4: Breaking Records and Breaking Stresses; Nickel Alloy Steels in the *Golden Arrow*. Pp. 8. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 22.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science and Technology), at 2.30.—Research on Infestation of Stored Products: (*a*) Entomological—(i) Survey and Inspection Work, W. S. Thomson, (ii) Biological Work, G. V. B. Herford; (*b*) Mycological, R. H. Bunting.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.—A. L. Parker: Artificial Silk.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—D. P. Dalzell: Heaviside's Operational Methods.—E. T. Hanson: The Dynamical Theory of Resonators.—E. C. Atkinson: Escapement Errors of Pendulum Clocks.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—T. W. Willis: Saws: Their Manufacture and some Hints on their Use.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5.30.—J. M. Thorburn: Spengler's Æsthetic.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—H. W. Rowell: Commercial Synthetic Resin Products.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. S. Atkinson and others: The Utilisation of Low-Grade and Refuse Fuels, including Towns' Refuse.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. D. Bush: The Quick-Running Oil Engine applied to and used in Railway Service.

ROYAL SOCIETY OF MEDICINE (Epidemiology and Tropical Diseases Sections), at 8.—Discussion on Brucella Infections in Man and Animals. Openers: Dr. W. Dalrymple-Champneys (Epidemiology), Dr. J. T. Duncan (Tropical).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Aero Wheels and Tyres.

SATURDAY, NOVEMBER 23.

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11 A.M.—Prof. R. R. Gates and D. V. Daran: Zygospore Formation in *Mucors*.—Miss J. Grove: Growth Reactions of *Helotium scutula* Karst.—Dr. R. G. Tomkins: The Relation of Mould Growth to Humidity.—Dr. H. Wormald: Some Recent Observations on Brown Rot Diseases of Fruit Trees.—E. C. B. Wright: Sexual Reproduction in *Penicillium*.

MONDAY, NOVEMBER 25.

INSTITUTE OF ACTUARIES, at 5.—H. J. Tappenden: A Valuation of Non-Participating Policies without Classification.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—C. Wade and others: Discussion on Wooden Poles for Overhead Transmission Lines, and their Preservation.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—W. H. Goddard: The Mercédès-Benz Diesel Engine.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—P. Morgan: Welsh Wools.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. G. Richardson: Wind Instruments from Musical and Scientific Aspects (Cantor Lectures) (II.).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—J. H. Badcock: The Design of Partial Dentures Considered in Relation to the Health of the Oral Tissues.—F. St. J. Steadman: A Dentigerous Cyst in Connexion with a Supernumerary Incisor.—Dr. E. W. Fish: A Report on Dr. Gottlieb's Histological Study of the Results of Traumatic Occlusion.

MEDICAL SOCIETY OF LONDON, at 8.30.—Clinical Evening.

TUESDAY, NOVEMBER 26.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—A. F. Evans: The Origin and Development of Heavy Oil Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at University College, Nottingham), at 6.45.—E. H. Smythe and E. G. Weeks: Low-Temperature Carbonisation of Fuel, with Special Reference to its Combination with the Production of Electricity.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: Heating of Buildings Electrically by Means of Thermal Storage.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Chamber of Commerce, Birmingham), at 7.—G. W. Woolliscroft: The Modern Development of the Steam Locomotive.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Dr. S. O. Rawling: How it works in Photography: A Chemist's Notions about Sensitivity (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Graduates' Section) (at Works of Bristol Tramways and Carriage Company, Ltd., Brislington, Bristol), at 7.30.—E. W. Sisman: Braking Topics.

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath), at 8.30.

WEDNESDAY, NOVEMBER 27.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—J. Menton and H. W. Steele Bodger: The Improvement in the Public Milk Supply: is Pasteurisation Necessary?

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District) (at Manchester Town Hall), at 6.—Parliamentary Bill Proceedings.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—F. R. Banks: The High-Speed, Compression-Ignition, Heavy-Oil Engine.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. S. Coates: Modern Boiler Practice (II.): Boiler Feed Water Conditioning.

TEXTILE INSTITUTE (Lancashire Section) (at Art School, Macclesfield), at 7.30.—A. J. Hall: The Physical and Chemical Properties of Cellulose in Relation to Technical Treatment of Cotton and Artificial Silk.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Globe Hotel, Leicester) (jointly with Foreman Dyers' Guild), at 7.45.—F. Willis and W. A. Edwards: A Short Résumé of the Manufacture of Hosiery Goods with Special Reference to Difficulties met with in Dyeing and Finishing.

ROYAL SOCIETY OF ARTS, at 8.—C. N. Kemp: The Examination of Coal and Coke by X-Rays (Dr. Mann Lecture).

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 8.—J. Strachan: Production and Treatment of Cellulose in the Paper Industry.

THURSDAY, NOVEMBER 28.

IMPERIAL COLLEGE CHEMICAL SOCIETY (at Royal College of Science), at 5.—Prof. H. V. A. Briscoe: The Work of the Coke Research Committee (Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Marion Richardson: The Teaching of Handwriting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. W. Taylor: Voltage Control of Large Alternators.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—G. S. Baker: Wake.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Squadron Leader H. M. Probyn: Flying and Maintenance from the Owner's Point of View.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Informal Meeting), at 7.—A. S. Newman: The Care and Upkeep of Amateur Kinema Apparatus.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Section) (at Royal Hotel, Luton), at 7.30.—S. W. Dixon: The Automobile Compression Ignition Engine.

INSTITUTION OF AUTOMOBILE ENGINEERS (Newcastle-upon-Tyne Centre) (at Y.M.C.A., Newcastle-upon-Tyne), at 8.—A. Healey: The Pneumatic Tyre in Heavy Transport.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—F. Llewellyn Jones: The League of Nations and the International Control of Dangerous Drugs.

INSTITUTION OF MECHANICAL ENGINEERS (Cardiff Branch).—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

FRIDAY, NOVEMBER 29.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. H. Parsons and others: Debate on The Registration of Reliable Tests of Power Plant Machinery.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. C. Freeman: Modern Welding Systems and Applications.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—Dr. J. N. Friend: Science in Antiquity.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates' Section) (at 51 West Regent Street, Glasgow), at 8.—J. W. Robertson: Two-stroke Engines: Some Experiments on a New Type.

SATURDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 22.

KING'S COLLEGE (at 40 Torrington Square, W.C.1), at 5.30.—Dr. O. Odlozilik: Outlines of Czechoslovak History (I.): The Geography of Czechoslovakia.

SURVEYORS' INSTITUTION, at 5.30.—Dr. A. W. Hill: Kew and its Relation to Botanical Enterprise in the Empire (Institution of Professional Civil Servants' Lecture).

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Village Life in the Middle Ages.

MONDAY, NOVEMBER 25.

UNIVERSITY COLLEGE, at 2.—Prof. H. Spencer: Medicine in the Days of Shakespeare.

LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers: The Exploration of Inner Africa.

UNIVERSITY OF LEEDS, at 5.15.—Dr. F. W. Aston: Atomic Masses.

SCHOOL OF ORIENTAL STUDIES, at 5.30.—Dr. W. R. Rickmers: The Alai—Pamirs—a Geographical Background of Oriental Studies. (Succeeding Lectures on Nov. 26 and 28.)

TUESDAY, NOVEMBER 26.

UNIVERSITY OF LEEDS, at 8.—Prof. M. J. Stewart: Disease.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Manchester).—Dr. G. C. Simpson: Past Climates (Alexander Pedler Lecture of the British Science Guild).

WEDNESDAY, NOVEMBER 27.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. S. L. Cummins: Some Aspects of the Tuberculosis Problem.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—A. Lloyd-James: Accent as an Element in Speech.

KING'S COLLEGE, at 5.30.—Prof. R. R. Gates: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: The Sciences of Life.

UNIVERSITY COLLEGE, at 5.30.—L. McColvin: Some Aspects of the Future of Public Library Work.

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—Dr. C. H. Lander: Physics in Relation to the Utilisation of Fuel (Institute of Physics Lecture).

NORTHAMPTON POLYTECHNIC INSTITUTE, at 7.—Dr. H. J. Gough: The Strength of Metals in the Light of Modern Research (Armourers and Brasiers' Company Lectures) (I.). (Succeeding Lectures on Dec. 4 and 11.)

FRIDAY, NOVEMBER 29.

COLLEGE OF MEDICINE (Newcastle-upon-Tyne), at 8.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 30.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Hydra in Fact and Fiction.

CONGRESS.

NOVEMBER 22 AND 23.

PUBLIC WORKS, ROADS, AND TRANSPORT CONGRESS (at Royal Agricultural Hall).

Friday, Nov. 22, at 11 A.M.—B. P. Davies: Economical and other Considerations in connexion with Roads and Bridges.—H. P. H. Morgan: Practical Points to be considered in the Improvement and Widening of Main Roads.

At 3.—W. J. Jones: The Application of Electricity to Roads from the Point of View of Street Lighting and Traffic Signalling.—J. Hunter Smith: Reflections on the Purposes and Scope of Agricultural Education.—Capt. G. A. Wright: Land Drainage.

Saturday, Nov. 23, at 11 A.M.—R. Beveridge: Costing as an Aid to Economy.

NATURE

SATURDAY, NOVEMBER 30, 1929.

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Native Education in Africa.

IN no part of the British Empire is the task of developing education services more difficult, onerous, and important than in British territories in Africa. In the Union of South Africa, the task is complicated by the language differences between the British, Dutch, immigrant Asiatics, and indigenous peoples, the different social customs and religions of the white, brown, and black elements, and the economic differences based upon the differing standards of living between these three distinct racial types. The situation in East Africa and parts of British Central Africa is much the same. In British West African territories, if we except the Cameroons, there is no white or Asiatic problem, but a complication exists because of an essential difference between the ideals underlying British colonial policy and those of the French and Belgians whose colonial territories are adjacent.

In his recent Rhodes Memorial Lecture at Oxford on "Native Policy in Africa", General Smuts pointed out that British colonial policy is enshrined in the Covenant of the League of Nations. Art. 22 of the Covenant lays down that to those colonies and territories taken from the Powers defeated in the War, which are inhabited by peoples not yet able to stand by themselves under the strenuous conditions of the modern world, there shall be applied the principle that the well-being and development of such peoples form a sacred trust of civilisation, and that this trust shall be carried out by the advanced nations. "The well-being and development of peoples not yet able to stand by themselves", says General Smuts, "can only mean the progress and civilisation of these backward peoples in accordance with their own institutions, customs, and ideas, in so far as these are not incompatible with the ideals of civilisation."

This is the ideal. It is one upon which education policy must be based in the British Colonial Empire, not only in the territories which the British administer under mandate from the League of Nations—and Great Britain, the Union of South Africa, Australia, and New Zealand, each have such mandates—but also in those territories for which we have been responsible for varying lengthy periods of years. In India for more than a century we have been attempting, however imperfectly, to put this ideal into practice. In West Africa, in Mauritius, in British Malaya, in the Sudan, our efforts have been in the same direction. Rhodes's conception of our responsibilities in Africa was substantially in harmony with the principle of

trusteeship : " white settlement to supply the steel framework and the stimulus for an enduring civilisation, and indigenous native institutions to express the specifically African character of the natives in their future development and civilisation ".

That the education of the natives of South Africa has only recently been developed in consonance with Rhodes's ideals has been due to the prejudices and short-sighted economic dogmas of the white settled populations. They attempt to justify their attitude by asserting that the native peoples can profit only by primary education, that they reach a phase of mental stupidity or ' saturation ' by the time they are adolescent. The intellectual successes of American West African negroes, and even the recent successes of South African Bantus at the South African College and the universities of Great Britain, leave many, we are almost tempted to say the majority of, Europeans in Africa, unconvinced that the native peoples are not inherently generally intellectually inferior. The consequence has been that, until quite recently, practically the whole responsibility for the education of the native peoples in South, West, and East Africa has been left to the various missionary bodies. In South Africa, although the native pays, in proportion to his means, much higher taxation than the white man, the amount spent on the education of the whites is many times the amount spent on five times the number of natives. Wherever there is a white settled population in our African Crown Colonies, the position is similar.

Fortunately, not even the active hostility of the majority of white settled peoples in Africa, South or East, has been able to withstand the explicit enunciation by the European powers of the principle of trusteeship with all its implications. The governments of the Union of South Africa, of Southern Rhodesia, of British West and East African colonies are now definitely committed to the provision of educational facilities for the African peoples, either directly by the creation of government educational institutions or indirectly by financial grants-in-aid to and government supervision of missionary schools and colleges, and a real start has been made. Since 1916 there has been a Native College in South Africa at which Bantu students can read for university degrees. In West Africa there are several institutions which take native students up to the standard of the entrance examination for universities in Great Britain or America —and there is every hope that before very long Achimota College on the Gold Coast will attain to the status of a university institution. At Makerere in Uganda a similar government institution has been created, one which already trains Africans for professional occupations, in addition to which Uganda boasts of several missionary institutions where the standard of education provided is above that of our matriculation. Nyasaland also provides, in many missionary centres, an advanced type of education for the natives. In Tanganyika the government has taken the lead in providing for the higher education needs of the native population, and in Kenya the training college for Jeanes (or itinerant) native teachers appears likely to exert a far-reaching influence upon the educational progress of the peoples of that country.

Southern Rhodesia, which enjoys a large measure of self-government, established a separate Department of Native Education at the beginning of 1928 under the direction of Mr. H. Jowitt. His first report,[1] which he presented to his legislative council recently, is worthy of careful study by those interested in African problems. Native education, considered as a government-aided system, covers a quarter of a century in Southern Rhodesia. In that period the number of grant-earning schools has increased from four to approximately 1600 : the grants have increased from £105 to approximately £40,000. The schools are classified under three heads : first-class schools are boarding schools under European supervision, following a prescribed code, including at least two hours industrial work a day, and with actual instruction by a European teacher on a reasonable number of days a year ; a second-class school is a day-school under a European teacher, who must give instruction on a reasonable number of days during the year ; and a third-class school is the ordinary kraal school where pupils are taught to read and write in a native language, with the elements of writing and arithmetic, for at least two hours a day. There are two government native schools which are not classified.

Altogether, about 2500 teachers, 270 of whom are Europeans, are engaged in the work of dealing with a school population of about 100,000. The classified schools are all the result of missionary effort, twelve distinct Christian missionary bodies having established schools in the colony. A large number of their schools have now been inspected by the officers of the new Department and the report throws an interesting light on their efficiency. The kraal schools are staffed for the most part by ex-scholars who have received no training for their

[1] Southern Rhodesia. Report of the Director of Native Education for the Year 1928. Pp. 48. (Salisbury : Government Printer, 1929)

ork other than that provided by the primary chool which they attended. Their standard of nowledge of school subjects is rarely above that f a boy or girl aged eleven or twelve in Great Britain. Their main work is to enable the pupils o gain sufficient knowledge to become Church nembers. Chief stress is laid on vernacular reading, particularly in relation to relevant portions of Scripture which must be mastered before the candidate can become a member of the Church. They are supervised by missionary superintendents, most of whom labour under the disadvantage of lack of knowledge of teaching technique and organisation of schools. The Inspector of Native Schools, Salisbury, in his first report to the Department, says, "I have on record at least 12 superintendents who are unacquainted with the Native language".

As the Director of Native Education remarks, it would serve no useful purpose to attempt a meticulous survey of the present curricula in the missionary schools. He has inherited a medley of schools in various stages of growth, staffed for the most part by uneducated, unknowledgeable men and women, badly paid, inadequate to their duties and responsibilities, muddling along without proper guidance and without proper buildings or materials. The facilities for training of teachers have been practically non-existent. "It can be stated without fear of contradiction that professional training, in the common acceptation of that term, hardly existed in most of these [training] centres before 1928."

This picture of the state of native education in Southern Rhodesia is by no means unique in Africa. There are other British Crown Colonies where the conditions are much the same.

Nevertheless, the future is promising. A tremendous effort is now being made in every part of British Africa to improve the educational standards of the native peoples. There is opposition to overcome, it is true, but most colonies have now a Department of Native Education. Most of the directors are men of courage, able, like Mr. Jowitt, to express clearly and forcefully the underlying social aims of an education system and its requirements, and possessing his faith that most of the native peoples of Africa are educable up to a very high standard. A properly organised system of education for the native peoples of Africa is the first requisite to the building up in Africa of a people able to enter into co-operative partnership with the Europeans in the task of developing the immense natural resources of a mighty continent.

Origin of Coral Reefs.

The Coral Reef Problem. By Prof. William Morris Davis. (American Geographical Society Special Publication No. 9.) Pp. viii + 596 + 16 plates. (New York: American Geographical Society, 1928.) 6 dollars.

IN 1913 Prof. W. M. Davis began to investigate the controversial subject of the origin of coral reefs. Since that time he has written numerous papers, and travelled many thousands of miles to see reefs for himself. This present volume incorporates the material of those papers and voyages, and enables those interested in coral reefs to obtain his views conveniently.

The appearance of this book is an event of considerable importance in geographical literature. Most writers on coral problems have been biologists, with the result that speculations on the origins of the different types of reefs have been somewhat varied and often have had but slight reference to the fundamental teachings of geology and physiography. It is not intended in any way to ignore or belittle the great importance of the biological study of reefs: far from it. But it is questionable how far a study of reef features and details is able to throw any light on to the origin of the reef as a whole. Looked at as an entity, a reef must clearly bear a close relation to the island or mainland which it borders, and if a reasonable interpretation is to be made of its origin, the physiographical characteristics of the shoreline must receive careful consideration. If, on the other hand, we are dealing with atolls, little direct evidence of their origin can be obtained from them. But, by deduction, we may draw certain conclusions about atolls from a study of elevated reefs or barrier reefs of other areas. In fact, the greatest difficulty of the whole coral problem is the origin of atolls: and a final answer to it can probably only be given when, if ever, we have a large number of deep borings made through characteristic atoll-reefs. Meanwhile, geographers, geologists, geophysicists, and biologists are able to help in solving this mystery by deduction until such borings are made.

It is, then, in the stress laid upon the physiographical and geological side of the problem that Davis has made such an important contribution to the already voluminous literature on the subject. Whatever criticisms may be passed on the book, it must be admitted, frankly and sincerely, by all who are interested in coral reefs, that Davis has succeeded in throwing much new light on the

problems awaiting solution, and in focusing attention on an aspect of the subject which had been sadly neglected. The interesting fact which stands out so clearly from Davis's work is that we are brought back once again to Darwin's views on the origin of reefs, which were first expressed more than eighty years ago. Since then numerous other theories have appeared, all of which have, directly or indirectly, made some contribution to the problem, but their main characteristic has been that they did not agree with the subsidence theory of Darwin and Dana. Davis, after reviewing these theories, and applying his deductive methods to the study of reefs both in the field and from charts, finds much evidence for reverting, with one or two minor modifications, to the Darwin-Dana hypothesis.

The only theory which Davis considers is a serious rival to the Darwin-Dana theory is the glacial control theory of Daly. It is not relevant to review here the merits of this theory, but it is important to appreciate that much of the future work on reef origins will probably involve fluctuations of sea-level and oscillations of sea temperature in the glacial period. The locking up of water in the great ice-caps appears to be an accepted fact: but we have still much to learn about the ice age, and if, as Depéret and others suggest, we have to deal with not one, but several fluctuations of sea-level in recent times, the coral problem may take on an even more complicated aspect than it has at present. Further, if we are to assume subsidence —often of great magnitude—we must consider seriously how such movements can occur. Is it enough, in other words, to assume that such subsidence has taken place because deductions drawn from a study of reefs lead us to think so? Must we not review the evidence in the light of recent geophysical work on the earth's outer shell?

The book is divided into two parts and contains an excellent bibliography. The first part deals with the leading theories of coral reefs: the theories are stated and criticisms advanced. The second, and by far the larger, part of the volume is devoted to the study of the facts of the problem. It is rather difficult to read this second part: so many points are reviewed and so many cases cited, that to assess adequately the real value of the subject matter necessitates either a visit to critical areas, or, at least, a careful study of large-scale charts. Nevertheless, the facts are marshalled in a masterly way, and much convincing evidence is brought together to show that Darwin's views are often better able to explain the known phenomena of various types of reefs than are those of any other worker.

On the other hand, one cannot avoid the feeling that, at times, Davis has allowed deduction to play too big a rôle in the matter, even though he himself admits, in such cases, the theoretical nature of his reasoning. For example, the explanation of certain features observable in the Fiji Islands is related to a moving anticline, so that, as the anticline passes, reefs alternately rise and fall. Or, again, in his account of the Great Barrier Reefs of Australia, Davis bases much of his evidence on some work of Andrews in northern New South Wales. Andrews there postulated a three-cycle development, which, Davis suggests, may also possibly apply to the Great Barrier Reefs. Quite apart from the fact that Andrews later modified his views, and so undermined the possibility of such an application, it does seem rather unnecessary even to try to extend a process of evolution relative to a region well to the south of the Barrier, to the reef area itself, which extends over one thousand miles. Deduction may be carried too far.

The volume contains an admirable and brilliant review of the coral problem, and the deductions of the author are usually clear and incisive. But there is yet much to learn about coral reefs, and the honest doubter may be excused if he asks for yet more definite knowledge about particular reefs and views somewhat critically the circumstantial evidence that Davis presents in favour of a complete acceptance of Darwin's views.

J. A. STEERS.

The "Index Kewensis".

Index Kewensis Plantarum Phanerogamarum. Supplementum septimum nomina et synonyma omnium generum et specierum ab initio anni MDCCCCXXI usque ad finem anni MDCCCCXXV nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii + 260. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 75*s*. net.

THE monumental "Index Kewensis" and its successive supplements are recognised as an indispensable part of the equipment of any important botanical institution, affording as they do a ready means of reference to the names, the first places of publication, and geographical distribution of all the known genera and species of flowering

plants published from the year 1753 down to the present day. In works of this character, the prompt appearance of the successive issues is of great importance, and it is therefore highly gratifying that new arrangements, mentioned in the preface, have made it possible to publish the seventh Supplement, which covers the period 1921–25, only three years after the appearance of the sixth, which covered the preceding quinquennium, 1916–20.

It may not be out of place to mention here a few of the many ways in which the Index is of service. If any question arises as to the correct or original way of spelling of a botanical name, the original spelling can be obtained from the Index, though obvious errors are of course corrected. Those interested in horticulture or economic botany may find out the native countries of the plants with which they are dealing and verify the names by means of comparison with the original descriptions cited in the Index. To the research worker in the systematic botany of the flowering plants, the Index, and especially its supplements, are absolutely indispensable, in view of the widely scattered nature of the literature: in illustration of this fact, it may be mentioned that about four hundred different periodicals were examined during the preparation of the present Supplement.

As each successive Supplement has been prepared, it has been the aim of those responsible to adopt any practicable modifications which would increase the general usefulness of the Index without altering its format. From the third Supplement onwards, lists of addenda, which were found to be very troublesome to consult, have been omitted, any new or corrected entries being inserted in the next issue. From the fourth Supplement, the dates of publication, so important for purposes of priority, have been inserted in all cases. The geographical information supplied is now much more detailed, the precise country or province being stated wherever practicable. Where new names are based on previously published ones, the latter are cited so that the connexion between the two names may be apparent.

A novel and invaluable feature incorporated in the present Supplement is a separate list of new genera, arranged under their families. This enables a botanist who is interested in one particular family, such as Orchidaceæ, for example, to see at a glance what new genera belonging to this family are contained in the supplement, information which is unobtainable from other sources without a prohibitive expenditure of time.

The present Supplement contains 260 pages, as compared with 222 in Supplement VI., the increase being due partly to the increased activity of botanical research during the period, and partly to the inclusion of many references which had been generally overlooked owing to their having been published in obscure periodicals or books. As regards the general style and typography, it may suffice to say that the present volume worthily upholds the high traditions of the Clarendon Press.

We are glad to see that Supplement VII. has been published only three years after the appearance of Supplement VI. The War naturally caused a delay in the appearance of Supplements V. and VI., but now, thanks to a special assistant (Miss M. L. Green) having been added to the Herbarium staff to supervise the laborious work of preparing the Index, the progress of the work has been considerably expedited. We notice in the preface that during the past twenty-two years the work of supervising the preparation of the Index has been entrusted to Dr. T. A. Sprague, who has carried out the work with great ability.

Sir Thomas Clifford Allbutt.

The Right Honourable Sir Thomas Clifford Allbutt, K.C.B. A Memoir by Sir Humphry Davy Rolleston, Bart. Pp. vii + 314 + 3 plates. (London: Macmillan and Co., Ltd., 1929.) 15*s.* net.

IT is fitting that Sir Humphry Rolleston should write a memoir of Sir Clifford Allbutt, his immediate predecessor in the chair of physic at Cambridge. Sir Humphry was closely associated with him in the great "System of Medicine", which has become a classic, and is near akin in his mental equipment both professionally and in his wide outlook. The memoir is so easy to read that only a close scrutiny shows how great has been the pains taken to get the facts accurately, to verify the references, and to maintain a due sense of proportion. All this Sir Humphry has done to perfection, and has succeeded in presenting a charming portrait of a learned physician who was also a cultured gentleman.

Born in 1836, a Yorkshireman, the son of the vicar of Dewsbury, Clifford Allbutt knew Charlotte Brontë and had seen Emily. He was thus able, in later life, to give a clear presentation of the position of the Brontës and to dispel the myths which were beginning to form round this remarkable family. As the son of a north-country vicar, he was not overburdened with wealth, but a classical scholarship defrayed the cost of his education at Caius College, Cambridge, from 1855. He decided,

however, to read science instead of classics, and took his degree after obtaining a first class in the Natural Sciences Tripos, gaining distinction in chemistry and geology. By this time he had shown some literary ability, had thought of becoming an artist, and had interested himself in music. The necessity of earning his living turned his attention to medicine. He entered St. George's Hospital, qualified, and settled in practice at Leeds, devoting himself from the beginning to medicine, and keeping himself during the lean years by writing for both lay and professional reviews.

Sir Humphry has taken Allbutt's life year by year, and elucidates his work by a running commentary which illustrates the main facts of a busy life with clearness and precision. First, the strenuous period (1861–1889), when as a physician he built up so great a consulting practice that he was nearly overwhelmed and accepted a commissionership in lunacy (1889–1892) as a relief. Lastly, the years (1892–1925), when he was Regius professor of physic in the University of Cambridge, a dignified post in which he found full scope for his many activities. During a portion of this last period, the similar post at Oxford was held by an equally remarkable man—Sir William Osler. Both were outstanding in their generation; in many points their characters agreed, in many they differed: Allbutt, a great English gentleman with the culture and something of the outlook of the older physicians, his thought based upon classical models; Osler a great humanist, with a wide knowledge of men gained in all parts of the world, one who looked forward rather than backward, versatile in all things, the founder of a school, endowed with an impish spirit he could not always restrain, which would have been quite foreign to Allbutt. Both were great teachers and brought to their classes an extensive knowledge of disease gained at the bedside. Both served their generation by writing text-books of world renown, so that their knowledge was not confined to the limited few who came into personal relationships with them. Both were absolutely honest in word and in deed, and both desired to advance professional knowledge by a wider education of the medical student, Allbutt by linking up human with animal pathology, Osler by improving historical knowledge and inculcating a love of the great masters in medicine and surgery.

These resemblances and these differences Sir Humphry brings out to admiration, and thus presents a picture of Allbutt as a leader of the medical profession. Incidentally, he shows how recent is the use of the clinical thermometer. Wunderlich, the second edition of whose book "On the Temperature in Disease" was translated in 1871, used a thermometer nearly a foot long and left it in the patient's armpit for twenty to twenty-five minutes. Allbutt, in 1867, had a short clinical thermometer made. It measured six inches in length, cost 7*s.* 6*d.* in a case, and recorded the temperature in five minutes. The length of the instrument was afterwards reduced to three inches, an index was supplied, Fahrenheit's scale was employed instead of the Centigrade, which would have been better, and by 1876 it was becoming standardised.

The book is illustrated with two portraits of Clifford Allbutt, which his friends will recognise as excellent likenesses, and there is a remarkably satisfactory index.

Heat Engines.

Steam and other Engines. By J. Duncan. Revised and enlarged edition. Pp. xi + 536. (London: Macmillan and Co., Ltd., 1929.) 6*s.*

IT has been very difficult during the last few years to recommend a text-book to the beginner in the study of heat engines, but it may be said that this new edition, containing as it does a treatment of the reciprocating steam engine, steam turbine, and internal combustion engine, has almost solved the difficulty. Entropy, total heat-entropy diagrams, and the mathematical treatment of steam turbines, are usually intended for advanced students; and to some extent their inclusion renders the book a little advanced for the first year man, while, on the other hand, the second year student will certainly find the treatment given rather insufficient. It would have been preferable to omit such semi-advanced matter and devote a special chapter to the study of condensers and air-pumps instead of using only four pages, and these mainly concerned with the marine condenser, for this important section of heat engineering.

Considerable additions have been made both in subject matter and illustrations, and these have been treated in the light of modern engineering practice. The chapter on the properties of steam calls for special comment. Here the author has added to his charts, so as to cover the higher pressures and temperatures now met with in large steam plants, and a valuable feature is the diagram showing the variations of specific heat of superheated steam at constant pressure with temperature and pressure. It is regrettable, however, that approximate formulæ should have been quoted for

liquid heat of water and specific volume of superheated steam, when the former can be read directly from Callendar's steam tables and the latter be calculated from the rational formulæ, also included in his tables.

It is surprising how many modern writers dealing with the action of steam in the cycles of a reciprocating engine still adhere to the old theory that initial condensation is almost exclusively responsible for all the losses, although it has been repeatedly shown by eminent authorities that this is not the case. The author is not altogether exempt from this criticism, despite the fact that 'leakage' is mentioned in a small paragraph.

The chapters on internal combustion engines form a welcome addition. The matter is well developed and the illustrations are numerous and well chosen, especially those dealing with the heavy oil engines, which are all of modern design. This part of the book, together with the description of a high-pressure marine steam plant, should prove of great interest to all engineering students.

The descriptive matter is very clearly developed throughout the book, indicative of the author's experience of good teaching practice, and the new edition can be said to be a distinct acquisition to a student's bookshelves.

Our Bookshelf.

Geology of Gold (*South Africa, Australia, New Zealand*). By E. J. Dunn. Pp. x+303+163 plates. (London: Charles Griffin and Co., Ltd., 1929.) 35*s*. net.

THIS treatise is founded on the author's personal experience in South Africa, Australia, and New Zealand. In the first-named country he spent many years, from about 1872 to 1886, when he left for Australia. His knowledge of the geology of these countries, especially in regard to the occurrence of gold, is perhaps unique. It is not quite up-to-date in regard to South Africa; although in the early days Dunn was a pioneer in South African geology, having given the first description of the Pretoria Series under the name of Lydenburg Beds, and the name of Dwyka to the famous glacial conglomerate.

The book contains much material founded on the author's observations in mines he has reported on; and his notes and diagrams are of considerable interest in connexion with ore genesis. In twenty-two chapters, the first of which is an introductory description of the earth's crust, he deals with country rocks, fissures, faults, lodes, dykes, veins, indicators, conglomerate reefs, walls of lodes, sources of gold, solubility of gold, secondary deposition of gold, metasomatic gold, minerals associated with gold occurrence, the forms of lode and alluvial gold respectively, the distribution of lode and alluvial gold, deep leads, high-level leads, and gold in glacial deposits. A special chapter is devoted to a description of the famous Mount Morgan mine in Queensland, which, from its inception to the end of June 1926, yielded 5,305,979 ounces of gold and 139,427 tons of copper, of the aggregate value of £29,739,276. This chapter is of especial interest, as the author had an opportunity of studying the secondary enriched ore, which is a feature of the Mount Morgan mine. On the occasion of the author's first visit, the daily yield from this ore amounted to 1000 ounces of gold. Exact surveys were made by the author while yet the mine was in a youthful stage, and at intervals, until the last of the secondary ore was removed. In this way a record was secured, and a complete suite of samples collected, which in the end was presented to the Victorian Mines Department.

Special attention is given by the author to the occurrence of alluvial gold, from which the bulk of the gold production of Australia has been derived, and the author's photomicrographs of the different forms of alluvial gold are of great interest and invaluable for reference and comparison. There are 250 photomicrographs, of which 60 are of alluvial gold and the remainder of lode gold and country rocks. The 172 diagrams (plans and sections) illustrate the occurrence of lodes and veins, faults, dykes, saddle-reefs (Bendigo, Victoria), indicators, auriferous conglomerates (Transvaal), and alluvial deposits. F. H. HATCH.

The Nautical Almanac and Astronomical Ephemeris for the Year 1931 for the Meridian of the Royal Observatory at Greenwich. Standard edition. Pp. vii+865. (London: H.M. Stationery office, 1929.) Paper, 5*s*. net; cloth, 7*s*. net.

THIS issue marks an epoch in the history of the "Nautical Almanac"; it is the first drastic revision of its general arrangement since 1834. All elements that were formerly given for Greenwich mean noon are now given for mean midnight; also, all the data referring to the sun are grouped together, and the same is done for the moon. The rectangular co-ordinates of the sun are given for midnight only, but first and second differences are printed, also auxiliary interpolation tables. The co-ordinates are given both for the equinox of 1950·0 and for that of 1931·0. It is desired to encourage the use of the 1950 equinox, and tables are given for reducing observed positions to this equinox.

For the convenience of users of calculating machines, both natural and logarithmic values of the sun's radius vector, Besselian day numbers, etc., are given. Much fuller information than before is given relating to the satellites of the planets. These include satellites VI. and VII. of Jupiter, but not VIII. or IX.; it is to be hoped that they may be included in the future. The list of observatories has been revised and extended. The inclusion of Uranibourg among "Former observatories" will be welcomed. The table of Julian days has been expanded, and now includes day 0 of each month from 1850 to 1940; outside these limits there are reduction tables, which diminish the risk of error.

There are two interesting essays in the volume; that on the calendar is by Dr. J. K. Fotheringham, and it gives full details both of ancient and modern calendars. We learn that Ptolemy Euergetes anticipated Julius Cæsar in 238 B.C. in trying to introduce a leap day every fourth year; but the attempt remained unsuccessful until two centuries later. The other essay is on time, and contains the statement that in the 1933 Almanac the short-period nutation terms will be included in sidereal time, which will be given to the third decimal of a second. This is in recognition of the great improvement in clocks in recent years, as a result of which it is considered desirable to be able to obtain mean sidereal time, freed from nutation.

Dr. Cowell ascribes much of the credit of the improvements in the Almanac to the deputy superintendent, Dr. L. J. Comrie.

The Earth and its History: a Text-book of Geology. By Prof. J. H. Bradley, Jr. Pp. vii + 414. (Boston, New York, Chicago and London: Ginn and Co., Ltd., 1928.) 12*s.* 6*d.* net.

THIS book is "written for the general student who desires to be intelligent about the earth", but as a guide with that laudable object it cannot be regarded as wholly satisfactory. It is written in a vigorous and picturesque style, and is copiously illustrated with many excellent illustrations. Unfortunately, the author appears to have lost touch with modern advances in geology. The treatment of isostasy is feeble. The views of T. C. Chamberlin dominate in the discussion of cosmogony and orogenesis, and it is suggested that the belief in a formerly molten earth is fast losing its popularity. This is not the reviewer's experience. The account of the age of the earth is very inadequate, for the author has clearly not yet liberated himself from the former prejudice in favour of a '100 million year' earth. He is sceptical of the validity of radioactive methods—for no good reasons—but compromises with a chart showing 225 million years for the Cambrian and 500 million years for the oldest Archæozoic. Such a compromise is highly unscientific, for there is no evidence whatsoever, and never has been, supporting figures of this order. One would expect a new book on geology to refer to the investigations carried out under the auspices of the Carnegie Institution in the field of vulcanology, but here there is no mention of any such recent work. Despite its attractive features, the book cannot be regarded as other than old-fashioned in its treatment of current problems.

Radium Treatment of Cancer. By Stanford Cade. Pp. x + 158 + 13 plates. (London: J. and A. Churchill, 1929.) 15*s.*

THE author states in the preface that in this book he has tried to illustrate the technique of radium in cancer in various anatomical situations and some of the results obtained by it by quoting selected cases. After a few short chapters on radioactivity, the methods of irradiation and the general principles of radium therapy, the author describes, often with the aid of coloured plates, the surgical methods at present in vogue in the treatment of cancer by means of radium.

The book will probably prove of much interest to surgeons who require detailed information of this character. They may have some difficulty in the section on p. 6, devoted to units, as some of the statements require correction. The author says that the principle underlying modern radium therapy is that of prolonged irradiation with small doses. It might reasonably be objected that the main principles underlying this therapy are of a much more general character than one aspect of the time factor.

The book is well produced, and some of the coloured plates give good impressions of the local effects which can be got by means of radium inserted into the tissues.

Field Book of North American Mammals: Descriptions of every Mammal known north of the Rio Grande, together with Brief Accounts of Habits, Geographical Ranges, etc. By H. E. Anthony. (Putnam's Nature Field Books.) Pp. xxv + 625 + 48 plates. (New York and London: G. P. Putnam's Sons, 1928.) 15*s.* net.

IN this convenient volume, which the field naturalist can without grumble slip into his holiday baggage, or on occasion into his pocket, are described 1445 species and subspecies of mammals—the full complement of the American continent north of the Rio Grande. It is a masterpiece of condensation, discussing in detail the habits and characters of at least one prominent species in each group, and stating geographical ranges and external characters sufficiently to guide the layman in almost every case to the identity of even related species and subspecies. The task of identification is lightened by 32 plates, each containing from two to thirteen excellent coloured figures, by abundance of lively and characteristic pen drawings and photographs, and by maps illustrating the distribution of geographical races. The author has produced a model of what a field-book ought to be.

List of the Vertebrated Animals exhibited in the Gardens of the Zoological Society of London, 1828–1927. Centenary edition in 3 volumes. Vol. 1: *Mammals.* By Major S. S. Flower. Pp. ix + 419. (London: Zoological Society of London, 1929.) 25*s.*

DURING the hundred years of its existence the London Zoological Gardens have exhibited no fewer than 949 species of mammals, representing probably most of the forms ever likely to be seen in captivity. This systematically arranged list, however, is much more than a historical catalogue of zoo exhibits. It is a valuable work of reference, giving the standard scientific name of each species, references to the original description and to a figure where such exists, synonyms, and not least interesting, the popular, local, or trade name. The first and last of these items ought to make for the standardisation of popular and scientific names in the exhibits of museum collections, where a lack of uniformity in different institutions tends to confuse the ordinary visitor.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Continents and Oceans.

EVER since Wegener published in 1915 his remarkable theory of the drift of the continents and the movement of the poles, most of us have viewed a map of the world with entirely different eyes, and it has become almost instinctive to look for correspondences between the outlines of the continents and relationships between the continents and the oceans.

In this short note I wish to comment on three or four of these relationships which have struck me in my own contemplation of the subject. I imagine that they have all been noticed before, but I do not remember seeing any discussion of them.

A thing which has struck me over and over again is the symmetry of the present distribution of land and sea with reference to the present position of the earth's axis. The north polar ocean is almost circular in shape and the pole is practically at the centre of the circle. Antarctica is a circular continent and the south pole is at its centre. The great land masses of the northern hemisphere send out protuberances towards the south which, roughly speaking, all extend to the same latitude, leaving a belt of ocean encircling the globe between latitude 40° S. and 70° S., which can truthfully be described as being symmetrical about the earth's axis.

These three examples of symmetry are clear and striking, but there is another example which, although less striking, appears to me to be of equal importance, and that is the orientation of the land masses themselves in relation to the earth's axis. If my reader will open an atlas at the map of the world on Mercator's projection, he will, I think, notice the following points. In the first place, the continents appear to be standing upright. This appearance is largely due to the north-south trend of the main peninsulas, but there is much more in it than that. The main continental masses appear to have been placed in the rectangular network of the Mercator projection in the most symmetrical way possible. The best way to explain what I mean is to consider the one continent which is abnormal. South America does not 'look straight'. One feels that it is necessary to give it an anti-clockwise twist to get it right. Looking now at North America, one does not have that feeling, it already looks straight; while Australia is itself almost rectangular with sides parallel to the network. Africa is quite upright, and when one considers the whole block of Africa, Europe, Asia, and Australia, one feels that in any different orientation it would not fit the framework of the Mercator chart. I find it impossible to put this in a more concise form or to express the symmetry in mathematical language; but every one who will take the trouble to look at the map will see what I mean. That the land masses are symmetrical to the network of a Mercator chart simply means that they are symmetrical to the earth's axis, thus I feel justified in considering this good evidence of the symmetrical arrangement of the present distribution of land and sea.

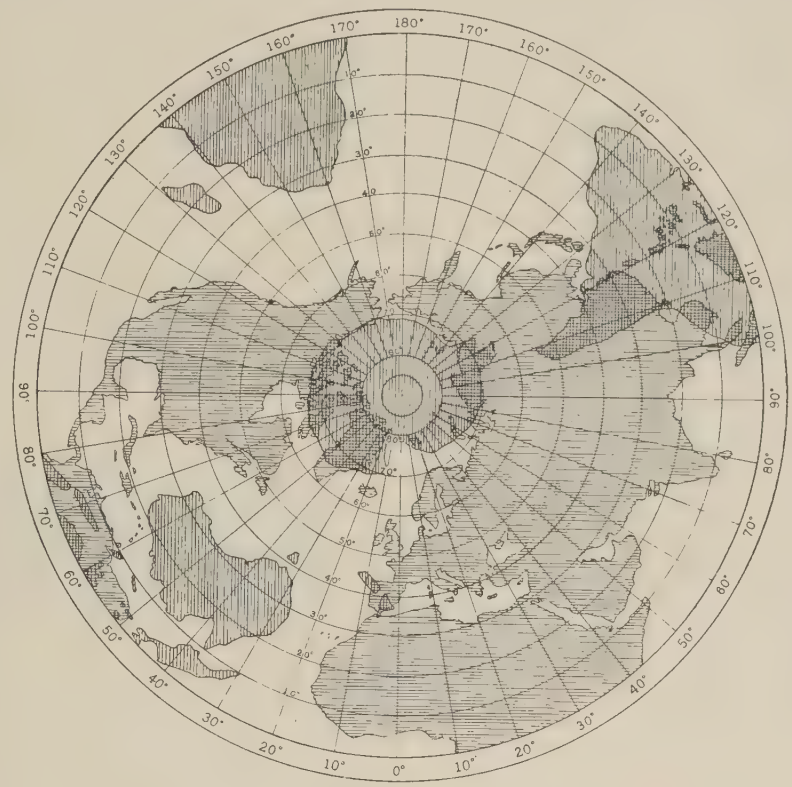


FIG. 1.

There is another characteristic of the present distribution of land and sea to which I personally have never seen any reference, namely, that, with one small exception, all the continents have oceans for their antipodes. That this might be expected to a large extent follows from the fact that the land masses are largely concentrated in one hemisphere, but I do not think many realise how completely the relationship is carried out in detail.

In Fig. 1 the distribution of land and sea in the two hemispheres is represented in such a way that every point in the northern hemisphere has its antipode superposed upon it. The land of the northern hemisphere is indicated by horizontal hatching, and the land of the southern hemisphere by vertical hatching. In the southern hemisphere there are four large land masses and it will be seen that three of these fall completely free of the continental blocks of the northern hemisphere, and the way in which Antarctica and Australia find oceans to fit them is almost uncanny. The southern part of South America is the only continental land of the southern hemisphere which has a continent as its antipode in the northern hemisphere: Is it significant that this is the only continent which we felt was not symmetrical to the earth's axis and required twisting to bring it straight, a twist which, it may be mentioned, would bring it clear of its Asiatic antipode?

The relationships which I have indicated may be entirely fortuitous or they may have a deep significance. I do not wish to discuss here which is the more probable, but I cannot help remarking that the chances against so many indications of symmetry being merely accidental must be very large. On the other hand, if they are not fortuitous but indicate some tendency to symmetrical distribution, that tendency must always have existed, and must be taken into account when discussing shifts of the pole. I do not wish these remarks to be considered to be evidence against the Wegener theory, for I feel more strongly than ever that only by a shift of the continents can the climates of other geological ages be explained.

G. C. SIMPSON.

Meteorological Office,
Adastral House, Kingsway, W.C.2.

Raman Spectra in Atmospheres Surrounding Metallic Arcs.

THE spectrum of the mercury arc in an atmosphere of carbon dioxide at a pressure of 6 cm. of mercury contains two faint lines coinciding in position with the two Raman lines recorded by Rasetti (NATURE, Feb. 9, 1929). Our spectrogram was taken in connexion with a study of the spectrum of the mercury arc (Fig. 1)

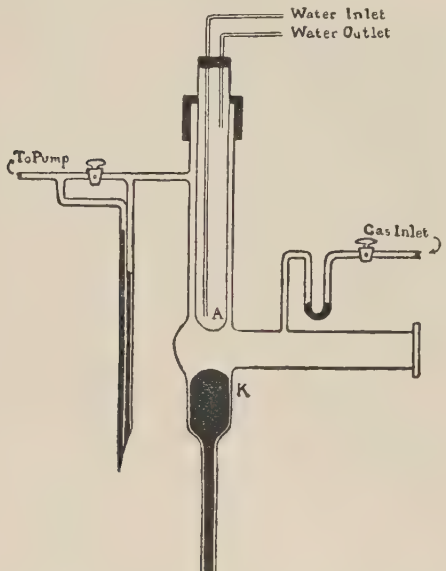


FIG. 1.—*A*, Water cooled anode; *K*, mercury cathode.

in atmospheres of foreign gases (*Indian Jour. Phys.* iv. 2, pp. 179-193; 1929):

Exciting Line.		Raman Line.		$d\nu$.	Rasetti's Value.
λ.	ν.	λ. (Int.)	ν.		
2536	39413	2622 (1)	38124	1289	1284 ± 10
		2628 (1)	38034	1379	1392 ± 10

That these faint lines are Raman lines of carbon dioxide is supported by the fact that they disappear when carbon dioxode is pumped out and do not reappear on the introduction of hydrogen. Other bright ultra-violet lines also show the corresponding Raman lines, which, however, are fainter than the above. This observation suggests a method of producing the Raman spectra of gases by running the exciting arc in an atmosphere of the gas. An attempt to obtain the Raman lines of carbon tetrachloride in the visible region by running a mercury arc in an atmosphere of carbon tetrachloride vapour was inconclusive on account of the complex band spectra occurring in the region.

Our results with carbon dioxide suggest a possible origin of at least some of the faint unclassified lines observed in all spectra. We have tested this hypothesis in the case of zinc and mercury, using Coblentz and Geer's extreme infra-red emission frequencies of mercury and zinc given in Kayser's "Handbuch der Spectroscopie", believing that they are molecular in origin. In the arc the formation of molecules, even in the case of monatomic vapours, is favoured by the presence of excited atoms. We find that in a considerable number of cases there are faint lines of intensity 1 or 2 corresponding to the calculated values. Moreover, nearly all these lines are marked nebulous; as an example may be mentioned the nebulous mercury line at 2687.

Exciting Line.		Raman Line.		$d\nu$.	Observed Infra-red Frequency.
λ.	ν.	λ. (Int.)	ν.		
2536	39413	2686·67 (1)	37209	2204	2206 (4·53 μ)

The above Raman line disappears when the arc is cooled (Fig. 2), a fact easily explained as due to the reduction in the concentration of the scattering molecular centres. Some of the faint lines of as yet unknown origin in the spectra of many celestial bodies

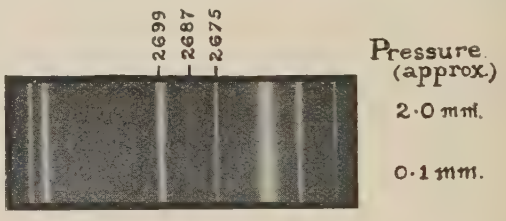


FIG. 2.

may turn out to be Raman lines produced in this manner. Allen (NATURE, Jan. 26, 1929) has given reasons for believing that certain faint lines in the secondary spectrum of hydrogen have a similar origin, the exciting radiation being the first few lines of the Balmer series. Kothari (NATURE, July 20, 1929) has adduced reasons for believing that the faint Fraunhofer lines are probably due to similar excitation and subsequent absorption, in the chromosphere of the sun.

A paper giving details will be published elsewhere.

B. VENKATESACHAR.
L. SIBAIYA.

Department of Physics,
Central College, Bangalore,
Oct. 24.

Norman Lockyer and the Total Solar Eclipse of 1875.

MAY I, for the sake of historical accuracy, beg leave to comment on two conflicting passages in the recently published volume, "The Life and Work of Sir Norman Lockyer", both referring to the total solar eclipse of 1875.

On page 82 it is stated that in Siam, clouds covered

the sun at the time of totality, and that the failure to obtain observations was disastrous from Lockyer's point of view. But in another place, page 245, it is, on the contrary, remarked that Lockyer found strong support for his dissociation hypothesis in the results of the 1875 eclipse observations.

A brief statement of the facts relating to this eclipse may serve to remove the confusion to which these conflicting passages may give rise.

The Committee of the Royal Society which organised the expedition decided to divide it into two sections, one of which was to proceed to Siam, while the other was to establish itself in Camorta, one of the Nicobar islands. When it appeared that Lockyer could not leave England at the time, owing to other duties, I was appointed head of the whole expedition so long as it remained united, while Meldola was to be leader of the Camorta section after their separation. It was this latter division that met with bad weather, the sky in Siam being cloudless. The results of the expedition were worked out jointly by Lockyer and myself and were published in the *Transactions of the Royal Society* (1878, Part 1). The photographs showed the calcium lines H and K, as well as some hydrogen lines at the base of the corona, but no other metallic lines.

ARTHUR SCHUSTER.

Yeldall,
Twyford, Berks.

SIR ARTHUR SCHUSTER'S letter gives interesting information about the 1875 eclipse, which the biography of Sir Norman Lockyer (for the relevant portions of which I am responsible) might well have included. It is not made clear there that the British expedition divided into two sections : apparently I assumed that Camorta was in Siam !

I have no reason to think, however, that there is any material inaccuracy in the passages referred to, although I have not now access to the papers before me when writing. Certainly the passages are not conflicting. The first states that Meldola, who was Lockyer's regular assistant, had a special programme of work arranged for him ; that the expedition was fruitless through clouds, although other parties were better favoured ; and that the misfortune was disastrous for Lockyer, who was left to develop his ideas without the guidance of observation at a crucial point. The second passage states that he found strong support for his ideas in the results of the eclipse observations.

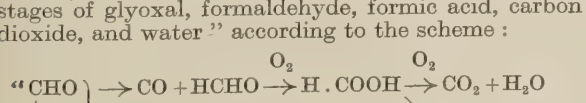
It is evident that observations might support existing ideas without giving guidance for future development—which is just what occurred in this instance. What Sir Arthur Schuster makes clear, and is not stated in the biography, is that the better favoured other parties included a section of the British expedition.

HERBERT DINGLE.

Imperial College of Science and Technology,
Nov. 16.

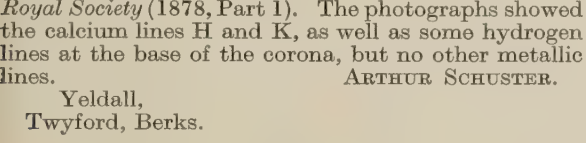
Combustion of Acetylene.

IN NATURE of Nov. 16, p. 761, Messrs. G. B. Kistiakowsky and S. Lenher announce that they have recently demonstrated that " The oxidation of acetylene by oxygen proceeds at 250°-315° through the stages of glyoxal, formaldehyde, formic acid, carbon dioxide, and water " according to the scheme :



and that " All these reaction products have been isolated ".

So long ago as 1905, in a paper entitled " The Combustion of Acetylene ", by Mr. G. W. Andrew and myself (*Jour. Chem. Soc.*, **87**, pp. 1232-1248) embodying the results of a detailed experimental study of the subject, and particularly of the interaction between 250° and 350° of various mixtures of acetylene and oxygen in the ratios 2 : 1, 1 : 1, 2 : 3, 1 : 2, and 1 : 3 respectively—in the course of which polyglycolide $(C_2H_2O_2)_x$ had been detected, and both formaldehyde and formic acid isolated and identified—the following statements summarising the matter appeared : " Experiments on the slow combustion of acetylene prove that carbon monoxide and formaldehyde simultaneously arise at an early stage of the process, probably as the result of the decomposition of an unstable product $C_2H_2O_2$, such, for example, as $\begin{matrix}C.OH\\C.OH\end{matrix}$. The production of formaldehyde certainly precedes that of steam. The whole process may, we think, be represented by the following scheme :



Below the ignition point the formic and carbonic acids produced at stages 3 and 4, respectively, break down, forming steam and oxides of carbon, whilst above the ignition point the formaldehyde produced at stage 2 (or possibly also the dihydroxyacetylene at stage 1) is resolved into carbon monoxide and hydrogen," and further, that " the initial stage of the combustion involves the formation of an oxygenated molecule $C_2H_2O_2$ . . . which rapidly breaks down to carbon monoxide and formaldehyde, the last-named product being subsequently burnt, through formic and carbonic acids, to a mixture of CO, CO_2 and steam ".

It was also found that " there is little to choose between the rates of combustion observed with mixtures corresponding to $2C_2H_2 + O_2$ and $C_2H_2 + O_2$, respectively, below the ignition point. An excess of oxgyen over and above an equimolecular proportion always retards the process."

While the recent experiments of Messrs. Kistiakowsky and Lenher have led them to adopt practically the same view regarding the mechanism of the combustion as we published twenty-four years ago, the results of our then experiments can scarcely be reconciled with their statement that " in packed vessels . . . a heterogeneous oxidation direct to carbon dioxide and water takes place ". We found that, on continuously circulating a $C_2H_2 + 3O_2$ mixture in a closed circuit comprising (i) a combustion tube packed with porous porcelain maintained at 380° and (ii) apparatus for removing both condensable and water soluble products, 96·1 of acetylene burnt gave rise to 84·9 carbon dioxide, 74·7 carbon monoxide, 32·6 formaldehyde, 58·6 steam, and 4·6 hydrogen, reckoning all products as gaseous and occupying the same volume at the same temperature. From this it was deduced that of the total formaldehyde theoretically formed at stage 2 of the combustion, 4·8 per cent had decomposed into carbon monoxide and hydrogen, 33·9 per cent had appeared unchanged in the products, while the remaining 61·3 per cent had been further burnt, through formic and carbonic acids, to oxides of carbon and steam.

One outstanding feature of the explosive combustion of acetylene to which we then directed attention, and which distinguishes its case from that of ethylene, is

that *on explosion with less than its own volume of oxygen*, no steam formation (indicative of the thermal decomposition of monohydroxy-acetylene) can be observed. In such circumstances, half the acetylene is burnt through $C_2H_2O_2$ to $2CO + H_2$, the other half being resolved by the heat into its elements together with a small amount of methane. I therefore agree that, in the combustion of acetylene, unlike that of ethylene and of other hydrocarbons, so far there is no evidence of a primary monohydroxy-stage, the initial stage apparently involving the direct formation of an oxygenated $C_2H_2O_2$ molecule. WILLIAM A. BONE.

Imperial College of Science and Technology,
London, S.W.7, Nov. 18.

High Temperature Allotropes of Manganese.

IN a communication entitled "A High-Temperature Modification of Manganese" (NATURE, Aug. 31, 1929) Messrs. Persson and Öhman confirmed, by means of the X-ray examination of the lattice structure of a series of copper-manganese alloys, the existence of the allotropic transformation of manganese which I had previously found to take place at $1191° \pm 3°$ C. and showed that its structure corresponded with that of the tetragonal modification, as determined by Westgren, of manganese obtained by electrolysis. They also found that the critical point $1024° \pm 3°$ C., on the other hand, did not seem to be accompanied by any change of crystal structure.

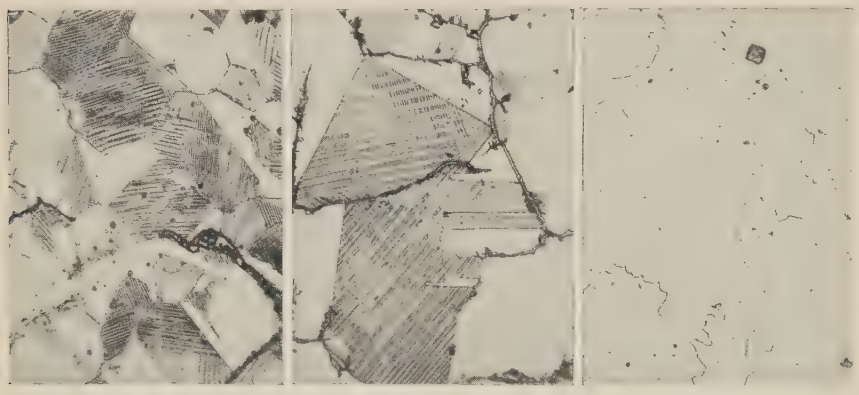


FIG. 1.—Microstructure of manganese after heat treatment at various temperatures and quenching in water. ×100. *A*, 2 hours at 975° C.; *B*, 2 hours at 1075° C.; *C*, 2 hours at 1220° C.

Shortly after the publication of my researches on manganese (*Jour. Iron and Steel Inst.*, **115**, 393; 1927) I carried out further experiments regarding the microstructure of the high temperature allotropes, and in view of Messrs. Persson and Öhman's results they may be of interest. Fig. 1 A and B show the microstructures of a sample of manganese which has been heat-treated in hydrogen for 2 hours at 975° C. and 1075° C. respectively and then quenched in water. It is evident on comparing these structures that no change in crystal structure has occurred on passing through the 1024° C. transformation point—which supports the view held by the above authors. Fig. 1 C shows the structure of the same sample of manganese which has been heat-treated in hydrogen for two hours at 1220° C. and then quenched in water; a change in structure has obviously occurred.

Messrs. Persson and Öhman suggest that, since γ-manganese, *i.e.* electrolytic manganese, is in reality a high temperature modification, that is sufficient to account for its rapid transformation into α-manganese by heating to 150° C. This also accounts for the fact that no thermal change was observed by me in pure manganese, prepared by distillation *in vacuo*, over ranges of temperature from 30° to 300° C. MARIE L. V. GAYLER.

National Physical Laboratory,
Teddington, Middlesex, Nov. 8.

The Charge of an Electron.

LAST January I proposed a theory of electric charge which led to a definite prediction of the numerical value of the constant $hc/2\pi e^2$. Since then I have been trying to obtain fuller insight into the more obscure parts of the theory—places where it was necessary to trust to a sense of analytical form rather than to any definite conception of the physical or geometrical meaning of the formulæ. I think that I have now been able to bring the theory into an improved form.

I hope to publish the full investigation soon; meanwhile I may state a result of general interest. According to the new calculation the value of $hc/2\pi e^2$ is 137. It is difficult to explain briefly the change from the former result (136); but, broadly speaking, it is due to the recognition that the 'rotation', which I introduced to represent interchange of the two electrons, is not one of the 136 symmetrical rotations of a pair of electrons, but is an antisymmetrical rotation which must be counted in addition. This was not very apparent so long as the rotation term was introduced solely as a consequence of the Fermi-Dirac principle; but the present theory goes more deeply into the origin of the term and makes clear its relation to the symmetrical rotations. A. S. EDDINGTON.

Observatory, Cambridge, Nov. 20.

Forestry Research in India.

IN connexion with the article on the above subject which appeared in NATURE of Nov. 16, I should like to explain that the words "Towards the end of 1900 the first research work by the Forest Department was commenced, when a member of the forest staff was appointed", referred to the fact that this was the first whole-time appointment made with the object of undertaking a definite line of research. Executive officers of the Department had been engaged upon research work before (and after) 1900 in addition to their own duties, as exemplified by the valuable work done by the late Sir D. Brandis, J. S. Gamble, and many others. When the Research Institute was incorporated in 1906, all the research officers were drawn from the gazetted ranks of the Department.

In view of the lamented death of Sir Sainthill Eardley-Wilmot, only a few days after the opening of the new research buildings at Dehra Dun, it may be added that, next to Lord Curzon, the officer most responsible for the new scheme was Eardley-Wilmot, at the time Inspector-General of Forests to the Government of India; for it was due to his vision and enthusiasm that the Research Institute came into being. THE WRITER OF THE ARTICLE.

Quantitative Chemical Analysis by X-rays and its Application.[1]

By Prof. G. HEVESY, Freiburg im Breisgau.

THE late H. J. G. Moseley was convinced that his discovery of X-ray spectroscopy would prove to be of value to analytical chemistry. He had chiefly the analysis of alloys in mind, and his well-known photograph of the brass spectrum, showing the stronger copper and weaker zinc lines, can be considered as the first application of X-ray spectroscopy in the field of analytical chemistry. His untimely death prevented him from attacking any other problem than the connexion between atomic number and X-ray spectra. The result of his endeavour is well known; it led him to discover the fundamental law governing X-ray spectra.

The first application of X-ray spectroscopy to the analysis of minerals was made in 1922 by Hadding in Siegbahn's laboratory. Shortly afterwards, Goldschmidt and Thomassen made a very exhaustive examination of the relative abundance of rare earth elements in a great number of different minerals. By comparing the intensity of the X-ray lines, they concluded that very marked differences exist in the relative abundance of neighbouring even and odd elements, and confirmed the generalisation put forward by Harkins and Oddo.

The important problem studied by Goldschmidt and Thomassen could be most satisfactorily solved without a strictly quantitative analysis, the differences between the abundance of neighbouring elements being very marked. The necessity for a strictly quantitative application of X-ray spectroscopy was, however, apparent when in the same year Coster and myself had to face the problem of the separation of hafnium from zirconium. The two elements being so similar, it was necessary when testing the efficiency of a separation method to determine small differences in the hafnium-zirconium ratio. We added to the sample to be investigated just sufficient tantalum oxide to make the hafnium La_1 and tantalum La_1 lines appear in equal intensity on the photographic plate, and concluded that in this case the unknown number of hafnium atoms present equalled the known number of tantalum atoms. Later, tantalum oxide was replaced by lutecium oxide and the intensity of the hafnium-$L\beta_1$ and lutecium-β_2 lines compared. The wave-length difference of two lines amounts in the latter case to four X-units only, corresponding to $\frac{1}{5}$ mm. on the photographic plate. Closeness of the wave-length of the lines to be compared is of great advantage. The intensity ratio of these lines was determined experimentally and was found to be 2·55. Similar considerations to those which led to the choice of lutecium as the reference substance for the determination of hafnium induced us to take erbium as a reference substance when estimating tantalum, the lines to be compared being in this case tantalum-La_1 (1518·3 X units) and erbium-$L\beta_2$ (1510·6 X units), to use niobium or thorium when estimating zirconium, and so on.

[1] Paper read at a joint discussion between Sections A and B of the British Association at Johannesburg on Aug. 1.

The investigation of cases like those above mentioned, where a mixture of a few refractory oxides is to be analysed, can easily be carried out. In other cases, however, we encounter appreciable difficulties.

SOURCES OF ERROR AND THEIR ELIMINATION.

(*a*) Error is due to the fact that the initial ratio of the unknown element to the reference element in the surface layer of the sample, which alone is accessible to the exciting action of the cathode rays, changes during the experiment. (The half-value depth for β-particles, for example, accelerated by 20,000 volts is, in zirconium oxide, only 2×10^{-5} cm.) This change, chiefly investigated by Coster and Nishina, is due to the effect of cathode rays on the sample; under the action of the latter, chemical reaction or melting of the sample can occur, which may lead to a partial separation or shift of one of the two elements to a deeper part of the sample which is inaccessible to the cathode rays. Their action may in the same way lead to evaporation or electrostatic repulsion of one or both components.

(*b*) The presence in the sample of other substances than the element to be estimated and the reference substance, which we shall for the sake of brevity call 'impurities', though they may constitute the larger part of the mixture, may influence the intensity ratio of the two lines. First, one of the two lines may be absorbed more strongly by the impurity than the other; and secondly, the X-rays emitted by the impurity may excite the two lines to be compared by secondary action and increase their intensity. This excitation can be a selective one, and can lead to a false intensity ratio due to the presence of the impurity.

The errors due to causes discussed under (*a*) can be eliminated by avoiding the use of cathode rays for the excitation of the X-ray spectrum of the sample to be investigated. Not the sample itself, but a target of tungsten is bombarded by cathode rays, and the X-rays thus produced are used to excite the spectrum of the sample to be investigated. This method of X-ray analysis, where the secondary radiation is analysed, will be denoted as the secondary method, and the usual method, where the spectrum is excited by cathode rays, as the primary method. The secondary method has been used in several cases in recent years both by Glocker in Stuttgart and in my laboratory, and has been found to work very satisfactorily. In my laboratory an electronic tube constructed by Coster, and admirably suited for this purpose, is used. By using 40 k.w. and 10 milliamp., a fairly strong copper-$K\alpha$ line can be obtained in the course of three minutes. The energy necessary to produce a secondary line is very appreciably greater than that for a primary line of equal intensity, but in the case of the secondary method a much larger current can be used—up to 100 milliamp. and still higher.

This is due to the fact that in the latter case the energy is distributed over the large surface, whereas in the former case it has to be focused on a comparatively small surface of the sample.

Besides the above-mentioned advantages, a further advantage should be emphasised. When determining elements present only in minute amounts in the sample, it is often necessary to expose the plate for a long time to the action of the X-rays: in the case of the primary method, the time of exposure is limited by the fact that the continuous radiation emitted by the anticathode darkens the plate and covers the weak lines. In the case of the secondary method, the continuous radiation reaching the plate being negligible, the exposure can be continued for a very long time.

The curve on the left of Fig. 1 shows the analysis of cyrtolithe obtained by the secondary method; while that on the right shows the analysis obtained by the primary method. From the former the hafnium oxide content works out to be 11·1 per cent, in good agreement with the value obtained by analysing the zirconium oxide plus hafnium oxide extracted from the mineral (11·3 per cent), while the primary method gives an entirely false result.

While the errors due to the effect of cathode rays can be successfully eliminated by using the secondary X-ray method, as mentioned above, we may still encounter those discussed under (*b*). Selective absorption will occur when the absorption edge of an impurity, present in large quantities, is situated between the two lines to be compared. In this case a selective absorption of the line of the shorter wave-length can occur; for example, between nickel-$K\alpha_1$ (1655 X-units) and cobalt-$K\alpha_1$ (1785 X-units) the iron-K edge (1740 X-units) is situated. The presence of large amounts of iron

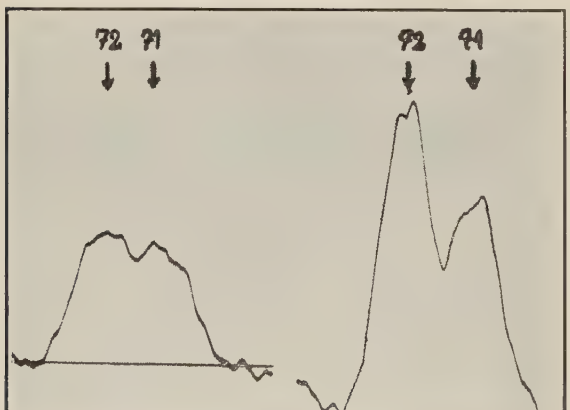


FIG. 1.—Photometer curves of cyrtolithe excited by X-rays (left) and by cathode rays (right).

in the sample can accordingly influence the intensity ratio. The most general remedy for such an error is to use very closely situated lines: when the wave-length difference is very small, the probability that an absorption edge will be situated between the two lines is only minute.

An example of the other case, in which strong lines of impurities are situated between the edges of the two elements to be compared, is the presence of large amounts of zinc in a mixture of tantalum and erbium. The strongest lines of the K spectrum of zinc (α_1; α_2; β_1) are situated between the edges of the latter elements. The zinc lines can thus excite erbium but not tantalum, and are bound to shift the equal intensity ratio in favour of erbium.

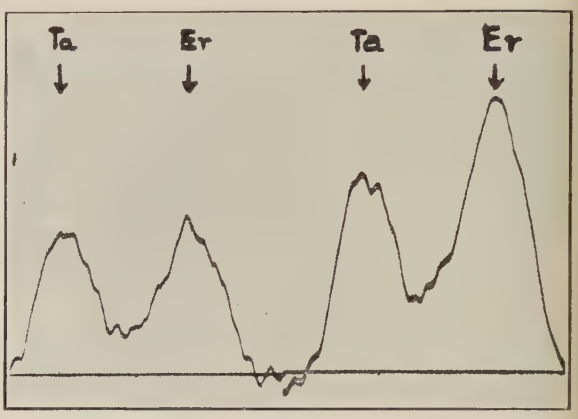


FIG. 2.—Photometer curves of equal intensity mixture of tantalum and erbium alone (on left), and of the same mixture with the addition of five atoms of zinc for each atom of erbium (right).

On the left-hand side of Fig. 2 is seen the photometer curve of the equal intensity ratio of an erbium–tantalum mixture, and on the right-hand side the same with five atoms of zinc present for each atom of erbium. The equal intensity ratio is altered by 20 per cent owing to the presence of the large amounts of zinc. In the not very probable case that tantalum should have to be determined in the presence of a large excess of zinc, a corrected equal intensity ratio would be necessary, or the erbium abandoned as reference substance and replaced by, for example, iridium.

A third case of disturbance is encountered when the absorption edge of the impurity is situated between the absorption edges of the two lines to be compared. This has, again, a weakening effect on the intensity of the line of the element with the absorption edge with the shorter wave-length.

The most general remedy for the disturbances we have just mentioned is the use of reference lines with closely situated edges. We mentioned previously as a remedy for other selective absorption errors the use of reference elements with closely situated lines; as both requirements—closely situated lines and edges—can only be found in a limited number of cases (about twenty), the X-ray analyst finds himself compelled to compromise between these two requirements. To be able to carry out accurate quantitative analysis of minerals or alloys with a great number of constituents, it is necessary to ascertain if large amounts of disturbing impurities are present and choose the reference lines suitable to the special case. If only an approximately quantitative method of determination is needed, these precautions are not necessary, nor are they necessary if an accurate analysis of a mixture of a few refractory oxides, for example, $ZrO_2 + HfO_2$ or $TiO_2 + Ta_2O_5 + Nb_2O_5$ is to be carried out.

Full tables containing suitable reference lines for elements between sodium and uranium will be published shortly.

Applications of the Analytical X-ray Method.

The chief field of application of the method of quantitative X-ray analysis is the determination of rare elements in minerals and alloys, but it can be applied to practically any element.

Minerals.—The determination of hafnium, which can only conveniently be done by the X-ray method, has already been mentioned. A further example of X-ray spectroscopy as applied to minerals is the case of tantalum and niobium. These can be separated by different chemical methods, but it is scarcely possible to effect a separation, or even to show the presence of the elements, when only traces are present in the mineral. For example, the presence of tantalum or niobium in the most important titanium minerals, such as ilmenite, titanite, rutile (apart from ilmeno-rutile and struverite, which are rich in tantalum and niobium), was not known before the application of X-ray analysis, in spite of the fact that the largest amounts of tantalum or niobium in the earth's crust are actually to be found in titanium minerals. This is due to the fact that niobium and tantalum generally accompany titanium in laboratory separations, and have likewise been deposited together by geochemical processes. They show conspicuously the phenomenon of a comparatively rare element being masked by a very similar abundant one, a phenomenon investigated by Goldschmidt and named by him ' camouflage '.

Tantalum and niobium being in many cases only present in a concentration of 1 in 1,000,000, it is necessary before applying the X-ray method to increase the concentration by a chemical one. Such a combination of chemical and X-ray methods proves in several cases to be very useful, especially in determining the abundance of the rarer elements in the lithosphere or in meteorites. While exhaustive data are available on the abundance of the more common elements, as shown by the well-known work of Clark and Washington, before X-ray methods were introduced, scarcely any data were available on the abundance of many of the rarer elements, though these constitute the majority. To determine the abundance of the latter in the lithosphere, the following method proved very useful. A large number of samples of igneous rocks were taken, in the same proportion as they occur in the earth's crust, and the mixture of the samples analysed by combined chemical and X-ray methods.

Alloys.—The method of quantitative X-ray analysis is very useful in investigating both common metals, such as commercial samples of iron, and also alloys of precious metals such as platinum. In the former case, minute amounts of vanadium, chromium, and so on, can also be determined by other than X-ray methods, for example, by the recently highly developed method of electro-analytical titration, but in this case it is necessary to dissolve the alloy, whereas in the X-ray investigation this is not necessary so long as the proportion of the metal present is not less than one in ten thousand. The X-ray method has greater advantages in the case of the platinum metals, where chemical analysis is very tedious.

Soil Samples.—The analysis of soil samples should be quoted as a third case. The phosphorus content, for example, can be determined conveniently and quickly by adding zirconium oxide to the sample and comparing the intensity of the phosphorus-Ka_1 and zirconium-$L\beta_1$ lines.

We have discussed so far the use of X-ray emission spectra for analytical purposes. An entirely different method of X-ray analysis makes use of the selective absorption by the sample containing the element to be determined. This method, worked out by Glocker, can be used where one heavy element is present in large excess over several light ones, but in general it is preferable to use the emission method.

We may refer in passing to the great progress made in quantitative optical spectroscopy. This progress is due to a great extent to the fact that the principle which was found very useful in the domain of X-ray spectroscopy, namely, the addition of a reference substance to the sample to be investigated, has also been introduced into optical spectroscopy. In the case of elements such as lead, zinc, cadmium, or the alkali metals, the optical method can be used with equal advantage, or in some special cases even more successfully than the X-ray method, but in the case of elements forming refractory compounds, such as the titanium group, the vanadium group, the rare earths, and so on, the optical method encounters serious difficulties which do not occur in the X-ray method.

Summary.

Quantitative analysis by X-rays is best carried out by first mixing the substance to be determined very thoroughly with a suitable reference substance. The intensity ratio of the reference line and the line to be determined is determined empirically beforehand. To avoid the disturbing effect of cathode rays, the sample is bombarded by X-rays, and the secondary spectrum investigated. As the presence of large amounts of certain impurities can influence the intensity ratio of the lines to be compared, it is necessary to know for each element under which conditions an exact determination is possible, and to choose the reference line accordingly. In the case of an approximate determination, and also in several cases of exact determination, this precaution is not necessary. The chief application of the method is the determination of rare elements present only in small amounts, where chemical methods more or less fail and the advantages of the X-ray method are most pronounced. Very promising also is the combination of the chemical and X-ray methods, as this allows, for example, a determination of all the rarer elements in the earth's crust and in meteorites. The analysis of soil samples (determination of the phosphorus content, etc.) and of alloys are further important applications.

Cancer Research.

THE twenty-seventh annual report of the Imperial Cancer Research Fund contains, in addition to the usual survey of the work published from the laboratory during the year, an unusual feature in the form of a review by Dr. W. Cramer of certain aspects of experimental carcinogenesis. It is proposed to include such critical commentaries in future reports, and there can be no doubt that this policy will enhance the value of these publications, for in no branch of medical research is it more necessary to pause from time to time to order our conceptions of the central problems.

The criticism is often made by those who are uninstructed in the facts that cancer research is sterile of results, and if by results is meant the complete explanation of malignant disease and the production of a perfect cure for it, the criticism is justified. But those who are better informed realise that, apart from some stupendous fluke, the secrets of cancer will only be revealed by persistent and laborious work in as many directions as possible. Unemotional work of this nature has been carried on by the Imperial Cancer Research Fund for twenty-seven years, and though it has not resulted in the elucidation of the main questions, it has provided us with such a wealth of detailed knowledge that we may claim to know more about the malignant processes than we do about many other biological phenomena that are accepted as the commonplaces of existence.

In this summary of the work of the current year, Dr. J. A. Murray, Director of the Fund, directs attention to certain observations which are of considerable interest. Continuing his work on carcinogenesis, Dr. W. Cramer has come to the conclusion that the development of carcinoma is not entirely due to changes occurring in the epithelium, but depends to some extent upon the removal of local inhibitory factors present in the other tissue elements. His observations suggest that the process of carcinogenesis consists of two phases—one a process of long duration which induces the condition of potential malignancy in the epithelial cells, and the other, a breaking down of the local resistance or inhibition which prevents the realisation of this potential malignancy. Exactly which of the tissue elements are concerned in this inhibition is not known, but it is possible that the wandering cells which accumulate under the hyperplastic epithelial cells of skin which has been treated with tar may be responsible. Certain observations by Dr. Ludford may have a bearing on this question. He has shown that in tumour-bearing animals vitally stained with trypan blue, the macrophages which take up the dye tend to accumulate around the tumours, though this distribution varies considerably in different types of growths. In view of the fact that the same type of macrophage is concerned with the taking up of metallic colloids from the blood-stream, it is possible that the action of metals on tumours may be an indirect one exercised through the macrophages.

Continuing his observations on the metabolism of the malignant cell, Mr. Crabtree, applying the method developed by Prof. Warburg to the numerous strains of transplantable tumours available in the laboratories of the Fund, has confirmed Warburg's discovery that the cancer cell can split sugar into lactic acid in a far greater degree then normal cells. Since this process is not confined to the cancer cell, it cannot be utilised as a test for malignancy, but it does indicate an important metabolic activity in which the tumour differs from the normal tissue; and since the metabolism of a cell is an expression of its vitality which can be measured, this technique offers a far better method for the study of the mode of action on the cell of therapeutic agents than we have hitherto possessed. Mr. Crabtree has started an investigation along these lines on the therapeutic action of radium which promises valuable results.

Owing to the work of Gye and Barnard, much attention has been directed of recent years to the study of the filterable tumours of fowls. Dr. A. M. Begg has studied such a tumour which in the course of three years has altered in character from a slowly growing fibro-sarcoma of low malignancy to a more cellular, more malignant tumour transmissible by cell-free extracts. It is highly probable, though not proved, that the tumour acquired the property of filterability with its assumption of a greater degree of malignancy.

An exceedingly significant observation on the Rous tumour has been made by Dr. Begg and Dr. Cramer. It has been claimed that it is possible to transform normal cells of the fowl into malignant cells by the action of various substances such as arsenious acid, indol, and skatol. Further reports have been published of the isolated production of the Rous sarcoma by the inoculation of extracts of normal fowls' testis or pancreas. These results have not been confirmed by other workers, but Drs. Begg and Cramer have brought forward evidence to show that such tumours may accidentally occur from the unsuspected contamination of laboratory apparatus with the virus of the Rous sarcoma. Such accidents are not unknown in the history of bacteriology, and the suggestion is made that these anomalous findings were due to experimental errors.

Dr. Cramer's review of experimental carcinogenesis is worthy of special study. The study of tar cancer in mice has thrown new light, for example, on such matters as the age incidence of malignant disease, and its occurrence in certain industrial occupations. It is responsible for the conception that different individuals of the same species vary in their susceptibility to the factors which are known to be associated with the development of malignant disease. If a certain proportion of human beings are susceptible to these factors, irrespective of dwelling-place, climatic or social conditions, the total incidence of cancer in all forms is likely to be the same in every nation; but local circumstances might lead to the relative prevalence of, say, intestinal or uterine cancer in any nation. This conception would offer a satisfactory explanation for the difference in the organ incidence of cancer which is such a striking feature in the statistics of different countries.

Obituary.

DR. CHARLES HOSE.

DR. CHARLES HOSE, whose death on Nov. 14 we much regret to record, was born on Oct. 12, 1863. From his father he inherited that love of wild Nature which characterised him throughout his life. As a boy, he was a keen naturalist and continued his habit of collecting and observing while at Felsted School. In 1882 he was admitted to Jesus College, Cambridge, but did not take a degree, as in his second year his uncle, the Bishop of Singapore, Labuan, and Sarawak, obtained for him a cadetship under Rajah Sir Charles Brooke, and on April 15, 1884, he landed at Kuching and was at once sent to the Baram district, where he remained for about eighteen years. In 1904 he was appointed Resident of the Rejang district and retired on Aug. 20, 1907, when he returned to England. In 1916, Dr. Hose was appointed superintendent of the munitions factory at King's Lynn, and in 1918 was chairman of the Cotton-waste Mills Investigation Committee.

Dr. Hose was given an honorary Sc.D. at Cambridge in 1900, and was elected an honorary fellow of Jesus College in 1926. He was a member of various scientific societies and the recipient of orders from several European countries. A list of the publications by Charles Hose, compiled by Prof. G. H. F. Nuttall, is given in "Fifty Years of Romance and Research of a Jungle-Wallah at Large" (1927), in which book will also be found an enumeration of the new genera and species of animals collected by him. A perusal of the titles of the papers written by Dr. Hose or with his collaboration, and of those dealing with the specimens he collected, will give some idea of his remarkable energy and the width of his interests. The result of his labours has been to add greatly to our knowledge of the zoology of Sarawak, and all anthropologists acknowledge the unrivalled extent and value of his contributions to the ethnography of that country.

Mention should also be made of the prolonged investigations made by Hose into the cause of beriberi; he came to the conclusion that the principal cause of this disease in Borneo was the consumption of mouldy rice. It is now admitted that the disease is frequently due to a preponderant consumption of white rice, that is, rice which has been polished by the removal of the husk and outer layers which alone contain the all-important vitamins. Dr. Hose's observations and experiments provided valuable data towards the elucidation of this problem. It was also due to his persistent efforts that the wealth of Sarawak has been enormously increased by the discovery and development of the greatest petroleum-producing area, except Burma, within the bounds of the British Empire. Hose was an insatiable collector, and a large number of museums throughout the world contain zoological and ethnographical specimens and collections given by him, but he did not neglect plants and geological specimens.

When I was preparing for the Cambridge Expedition to Torres Straits, I received a most cordial invitation for my party to visit Dr. Hose in the Baram district. His offer was so tempting in its promises that I could not refuse, and the results of that visit have been far-reaching. We had the opportunity of seeing the respect and affection in which the Resident was held by the varied tribes of the district, and how they came to him with their difficulties, which were often of a personal and intimate nature. None of us will forget the wonderful gigantic peace celebration which cemented friendship between various estranged tribes and incidentally proved the power and beneficence of the Government.

We found that Hose had a very extensive and detailed knowledge of the natives, which was stored in his remarkable memory and more or less recorded in notes. He then began to collaborate with Dr. W. MacDougall, and the partnership finally resulted in the great and richly illustrated work, "The Pagan Tribes of Borneo" (2 vols., 1912), which will be a lasting memorial to Charles Hose. It was a happy combination, for though he was supreme as a collector and observer, Hose had never had a scientific training, and the method and restraint of MacDougall were of great service in bringing the great wealth of crude matter into due form.

To the last Dr. Hose retained his youthful enthusiasms and outlook; he was always seeking to know about things, and when that knowledge was obtained he utilised it in various ways. He was essentially a field naturalist, and these qualities, combined with his genial character and his sympathetic appreciation of native thought and custom, enabled him to become a notable administrator who has left an indelible impression on his beloved Sarawak. A. C. HADDON.

PROF. RICHARD ZSIGMONDY.

SCIENCE generally has suffered a very severe loss by the recent death of Prof. Richard Zsigmondy, late Director of the Institute for Inorganic Chemistry at Göttingen. For years he has been one of the most prominent figures in the field of colloid chemistry.

Richard Zsigmondy was born in Vienna on April 1, 1865. Even as a young boy he showed great aptitude for experimental science, and he pursued the study of chemistry at the Technical High School at Vienna and at the University of Munich. After graduating for the degree of D.Phil., he became private assistant to Prof. Kundt at Berlin, and in 1893 he obtained his "Privatdozent" at the Technical High School at Graz. Four years later he was employed as scientific worker by the well-known firm of glass manufacturers, Schott of Jena. The outcome of his investigations with this firm was the preparation of a specially uniform Jena opalescent glass. After leaving the firm, Zsigmondy became a private teacher in Jena, and it was during this period that

he carried out and completed some of his most well-known investigations.

Zsigmondy's early work was concerned with glass and the colours produced by the presence of metals or metallic oxides. This led him to take up the study of colloid chemistry, and in 1898 he published his well-known work on colloidal gold. He successfully prepared gold sols of reproducible properties and showed that they owed their colour to minute particles of metallic gold, which were held in suspension by the electric charge they possessed. He further showed that removing this charge by the addition of electrolytes precipitated the gold and it was impossible to bring the precipitate back into suspension. Zsigmondy very quickly realised that the colour of his gold sols closely resembled that of gold ruby glass, and he turned his attention to this material, with the result that he definitely proved that ruby glass also owed its colour to the presence of very minute crystals of metallic gold.

Another problem which was attracting a great deal of attention at this time was the constitution of Cassius purple. Very many chemists, including Berzelius, believed that this substance was a chemical compound, but the whole question was satisfactorily solved by Zsigmondy when he synthesised the purple from colloidal gold and colloidal stannic acid. Furthermore, his method of determining the relative protective power of hydrophyllic colloids by means of the gold number is familiar to all colloid chemists.

These investigations on colloids proved that for the successful observation of these small colloidal particles more refined apparatus was necessary. Zsigmondy concentrated his energies on the solution of this problem and conceived the idea of the ultramicroscope, which, with the collaboration of Prof. Siedentopf, he brought out in 1904. This new apparatus enabled chemists to observe particles which hitherto had been invisible and it gave a new impetus to the direct study of the Brownian movement.

In 1907, Zsigmondy was called to Göttingen as Director of the Institute for Inorganic Chemistry, which he converted into a school of colloid chemistry where students from all over the world collected to study this branch of chemistry. During the early period of his stay at Göttingen, Zsigmondy turned his attention to the study of gels and gel structure, and he put forward the generally accepted capillary theory for the explanation of vapour pressure curves of silica gels as determined by van Bemmelen. His work during this period gave the study of gel structure a new interest and importance in the minds of chemists.

Later, Zsigmondy became interested in the preparation of collodion membrane filters. With characteristic thoroughness he explored the various ways and means of obtaining reproducible filters of definite and uniform pore size. This was essential if the filters were to be of any use in either colloid chemistry or bacteriology and biology. The final outcome of a period of intensive investigation and experiment was the preparation of the now widely used Zsigmondy membrane filters. These investigations were carried still further with the production of very uniform ultrafilters of varying pore size down to a diameter of about 4 $\mu\mu$. With further work he succeeded in preparing 'cella' filters for use with organic solvents. Zsigmondy was awarded the much-coveted Nobel Prize for chemistry for 1925 in recognition of his important pioneer work in the comparatively new field of colloid chemistry.

Zsigmondy made some excellent contributions to the literature on colloids in general. In 1905 his "Erkenntniss der Kolloide", containing a full account of the development of the ultramicroscope and of his original work, was published. The first edition of his general treatise on colloid chemistry appeared in 1912, and a completely rewritten edition in 1927. Another contribution, in which he collaborated with Dr. Thiessen, is "Kolloides Gold", which is one of the few standard works on the subject.

In February 1929, Zsigmondy was forced by failing health to retire from his duties at the Institute, and in October last he died at his home at Göttingen. To those who had the privilege of working under him, it was felt as a personal loss of an inspiring teacher and a sincere friend, while the whole scientific world must feel that one of its great men has passed away.

Dr. T. Wemyss Fulton.

More than fifty years ago Thomas Wemyss Fulton and I worked side by side in Turner's dissecting-room in Edinburgh, with David Bruce and Noël Paton among our comrades there. D. J. Cunningham, then senior demonstrator, was studying the anatomy of the *Challenger* marsupials; the junior demonstrator was designing the Cathcart microtome; and the laboratory attendant, 'old Stirling', the real first inventor of the microtome, was making his exquisite preparations, as Goodsir had taught him to do. A prize, of some value for those days, was given for the best dissections of the year; I have forgotten its name, but I remember that I won it one year and Fulton the next. Scholarships were few and scanty. Many of us found some employment, to help pay our way—in part or whole; and Fulton, with indomitable strength, courage, and self-denial, was a telegraphist by night in the G.P.O. and a medical student by day. He graduated with first-class honours; and when he took his M.D., three years later, his thesis was a study of 'telegraphists' cramp', based both on observation and experience.

John Murray, a good judge of men, took Fulton as one of his assistants in the task of seeing the *Challenger* Reports through the press. After a couple of years of this useful experience, Prof. Cossar Ewart brought him into the Scottish Fishery Board's service; and there he remained, afterwards becoming the Board's scientific superintendent under the Act of 1895.

Dr. Fulton's own papers began to appear in the

Board's report for 1888, and the output went on steadily for thirty-four years. He made countless observations and not a few discoveries regarding fishes, their early development and subsequent rate of growth, their migrations and distribution, their habits and their food. Some of his best papers were those in which he demonstrated (in 1895 and later) the cyclonic surface-currents of the North Sea, and the influence of this circulation on the distribution of fish-eggs and young fishes.

Beam-trawling began in Scotland just a little while before Fulton came to the Fishery Board; the otter trawl followed about 1895, and at once ousted the beam; and the fishermen complained bitterly of the new industry. At first the Board was little in favour of restrictions; in 1884 it pronounced against a *mare clausum*, adding, however, that "the true principle is freedom, *qualified by such regulations* as in the common interest may be found just and necessary". Dr. Fulton's sympathies were all with the line-fishermen; he wished to protect them, and his influence had a deal to do with shaping the policy which closed the Firths of Forth and Clyde and the great area called the Moray Firth. He convinced himself, more than forty years ago, that there had "already been a gradual and considerable diminution of the average catch of Scotch beam-trawlers, per ton of the vessel's tonnage"; and he said that "it would not be seriously contested that the supply of fish, relative to the machinery of capture, has diminished and is likely to continue to diminish".

Very difficult questions soon arose out of the closure of the Moray Firth, and helped to turn Fulton's attention to the thorny subject of maritime law. In 1911 he published his *magnum opus*, on the "Sovereignty of the Sea". The lawyers have not always, I believe, seen eye to eye with him on matters of opinion or interpretation; but the book, obviously and admittedly, is a mine of historical information and curious learning. The earlier chapters, especially those on our troubles with the Dutch in Charles II.'s time, are delightful reading. D'ARCY W. THOMPSON.

COL. SIR THOMAS HOLDICH, K.C.M.G., K.C.I.E.

SIR THOMAS HUNGERFORD HOLDICH, who died on Nov. 2 at the advanced age of nearly eighty-seven, spent most of his active life in the Survey of India, where he was largely engaged on Frontier and trans-Frontier work. His commission in the Royal Engineers dates so far back as 1862. His first war service was with the Bhutan Expedition in 1865, followed by the Abyssinian campaign in 1867 and the second Afghan War in 1878–80. But his survey career will chiefly be remembered by his work on successive boundary demarcation commissions, and probably he served on more of these than any other office. In 1884 he was with the Russo-Afghan Boundary Commission in connexion with which the once famous, though now almost forgotten, Panjdeh incident took place. As superintendent of frontier surveys he was concerned with the extension of maps on and beyond the Indian frontiers. During this period he was engaged in 1894 on the demarcation of the eastern boundary of Afghanistan, between that country and the frontier tribes. In the following year he was with the Pamir Boundary Commission. Finally, he was appointed chief commissioner for the demarcation of the frontier between Persia and Baluchistan. In 1898 he retired after thirty-six years' service in India.

With such a record it is not surprising that Holdich was appointed, shortly after his retirement, to be a member of the tribunal dealing with the disputed boundary between Argentine and Chile, which had been referred to King Edward as arbitrator. This tribunal, presided over by the late Lord Macnaughton, heard evidence from both sides in London. A stage in the proceedings was reached, however, when it became necessary, through lack of geographical information, that the country in dispute should be inspected. For this purpose Holdich and a party of survey officers visited Chile and the Argentine during the winter of 1901–2. After the additional evidence thus collected had been placed before the tribunal, King Edward gave his award in the autumn of 1902.

In the meantime, the two countries decided that the actual boundary, as awarded, should be marked out on the ground in the presence of a commission appointed by the British Government. Holdich became chief commissioner for this purpose and again visited South America in the winter of 1902–3. The final settlement of this important boundary, which had been the cause of continuous and dangerous friction between Argentine and Chile, was at last completed. This was one of Holdich's most successful achievements. He possessed in an eminent degree the art of conciliating divergent elements, which gave him a great advantage in dealing with questions of this kind. He had the pen of a ready writer and was also a fluent and pleasant speaker. The excursions which he made into the historical and picturesque aspects of trans-frontier exploration were much appreciated. He was also an admirable artist, and brought back many pictures of the various places he visited.

Holdich's inclinations always seemed to tend towards the political, artistic, and literary, rather than to the scientific side of life, which did not really interest him. For his various services he was made at different times K.C.M.G., K.C.I.E., C.B., and C.I.E. He served as president of the Royal Geographical Society from 1916 to 1918, and he was the oldest holder of the Society's gold medal. He was the author of several works, notably "The Indian Borderland", "The Countries of the King's Award", and "The Gates of India".

H. L. C.

REV. CAMILLO MELZI D' ERIL.

FATHER CAMILLO MELZI D' ERIL, who died on Mar. 10 last, was born on Jan. 6, 1851, and thus at the time of his death was one of our oldest seismologists. He was educated at the Carlo Alberto College, Moncalieri, and later was admitted to the Barnabite Order. In 1873 he joined the teaching

staff of the Collegio alla Querce at Florence. Here he was a colleague of Father T. Bertelli, the founder of microseismology. For many years he was director of the geodynamic observatory belonging to the college. Following in Bertelli's footsteps, Melzi made a special study of microseismic motions, concluding that their frequency increased with a low barometric pressure, but that it was independent of the velocity of the wind. On the death of Bertelli, he contributed a valuable account of his life and work to the *Bollettino* of the Italian Seismological Society (vol. 10, pp. 179-196 ; 1904).

C. D.

We regret to announce the following deaths:

Sir Sainthill Eardley-Wilmot, K.C.I.E., from 1903 until 1906 Inspector-General of Forests in India, on Nov. 13, aged seventy-seven years.

Dr. Ninian McIntire Falkiner, for about twenty years Medical Superintendent of Statistics for Ireland, on Oct. 30, aged seventy-four years.

Mr. G. B. Francis, formerly a director of British Drug Houses, Ltd., who was an original member of the Society of Chemical Industry and for many years an honorary auditor of the Pharmaceutical Society, on Nov. 6, aged seventy-nine years.

Prof. G. A. Goodenough, since 1910 professor of thermodynamics at the University of Illinois, known for work on the properties of saturated and superheated vapours, on Sept. 30, aged sixty-one years.

Dr. James Cosmo Melvill, who was elected a fellow of the Linnean Society so long ago as 1870 and was also a past president of the Conchological Society, on Nov. 4, aged eighty-four years.

Sir Archdall Reid, K.B.E., author of works on heredity in man and allied subjects, on Nov. 18, aged sixty-nine years.

Dr. Samuel Rideal, president in 1918 of the Society of Public Analysts, who was well known for his work on sewage purification, on Nov. 13, aged sixty-six years.

Dr. Harold W. T. Wager, F.R.S., formerly H.M. Staff Inspector of Schools, Secondary Branch, Board of Education, who was president of Section K (Botany) of the British Association at the South Africa meeting in 1905, on Nov. 17, aged sixty-seven years.

News and Views.

The debate in the House of Commons on Nov. 20 on Empire timber resources was largely confined to a reiteration of the view that the world will be faced with a famine in softwood coniferous supplies in some thirty years' time. The debate originated from a resolution moved by Sir George Courthope to the effect "that the threatened shortage of commercial softwood timber demands the serious attention of His Majesty's Government". Sir George said that foresters regard the position with grave alarm. This, however, is stating but half the case, for many timber merchants agree with the foresters. On the other hand, there is a body of opinion comprising both foresters and timber merchants who do not acquiesce in this alarmist view. They hold that as the supplies of the commodity in question become less abundant prices will rise, other materials will replace, to some extent, the softwood timbers ; and that, with the ingenuity and adaptive faculty of the various trades, matters will readjust themselves. The arguments concerning the exhaustion of Canadian supplies in thirty years, the competition of the United States with the British Empire, and the scanty supplies which would by then be left in Northern Europe, have all been alluded to in our columns on previous occasions. It is not, however, apparent upon what source of information Sir George Courthope bases his statement that "in Russia, certainly within twenty-five or thirty years, production will be forced down to a limit which does not exceed their own requirements, and the capacity to export timber will have ceased". This is very far from being in agreement with opinions held by some continental experts, who are probably in a far better position to know the true position than most in Great Britain.

After an appreciative allusion to the ten years' work of the Forestry Commission, which has planted 140,000 acres of softwoods and 6000 acres of hardwoods, and has rendered assistance to local authorities and private enterprise to deal with some 50,000 acres more, Sir George Courthope said that the Commission would shortly be planting 40,000 acres a year. He suggested that a good deal could be done in encouraging the replanting and conservation of existing woods, that there is very definite scope for research, and that the laboratory at Princes Risborough will be so extended as to enable it to deal with forest products from all parts of the Empire. In the debate which followed, in which the replanting of areas felled during the War and since, was strongly stressed, Mr. Buxton stated that the late Government announced last spring a programme of £5,500,000 for the next decade's work with a planting programme of 237,000 acres and 1500 small-holdings attached. The plan adopted by the present Government involves a sum of £9,000,000, an area of 350,000 acres, and the provision of 3000 small-holdings, and it is hoped that this big programme will have a really useful effect on the rural economy in many districts and help to retain the rural population.

The cause of the preservation of the wild fauna of the British Empire cannot but benefit from the publicity given to it in the debate in the House of Lords on Nov. 21. No political partisanship is shown in this matter, for every speaker spoke with abhorrence of the slaughter which has been carried out under the name of 'sport'. Two widely different aspects of the question of killing wild animals cropped up in the course of the discussion. There is the new development of the running down and shooting of antelopes and the like by means of motor-cars, an inexcusable travesty of the sporting idea, which is not only condemned on all hands, but, as Lord Passfield pointed out, is also definitely illegal. The difficulty in Tanganyika is just that which confronts the animal protectionist, whether he is dealing with legal shooting grounds or great animal reserves, namely, that the law is bound to be ineffective in

face of the criminally disposed hunter, if the area is not under thorough surveillance by a large staff of wardens. This is an expensive business unless, as some of the colonies have contrived, the cost of supervision is borne by the profits made from the necessary reduction of surplus wild stock. The Legislative Council and the Governor of Tanganyika are doing their best to prevent illegal and excessive shooting, and the debate should encourage them in their efforts.

THE second aspect is the slaughter of wild animals by natives in their own territory. This question cannot reasonably be confined, as the Earl of Onslow suggested, to the protection of crops against depredations or of human beings against dangerous foes. From time immemorial the natives have depended on their own wild animals for food, and to deprive them of this right would seem to be a hardship. The difficulty is that in recent years there has been a tendency in some parts to slaughter for the sake of killing, irrespective of actual food requirements. We have been assured by African travellers that this development is directly due to the inordinate killing caused by sporting expeditions, the native, less passive than he would seem, saying to himself that since the whites are killing out the animals, he may as well kill them also. Here the cure would seem to be the setting of a good example rather than penalties which must give the impression of unjust differentiation. But where a real danger of extermination looms on the horizon, every effort must be made to protect the threatened creatures from anyone whomsoever. It strikes us as curious and inconsistent that while all this strong and unanimous discussion concerns itself with the wild creatures in wild country, where the danger of extermination is on the whole far off, men may still kill the last remnants of some of the interesting relics of the British fauna, to their own considerable profit, and without running the risk of the slightest penalty, for except in the case of the grey seal there has been no attempt on the part of the British legislature to protect British mammals.

SUBJECT to the approval of the Charity Commissioners, an agreement has been reached between the Radcliffe Trustees and Sir William Morris, Bart., president of the Radcliffe Infirmary, by which the Trustees will sell to Sir William (on behalf of the Infirmary and the University Medical School) the whole of the Observatory grounds, which extend to more than nine acres, and the Trustees will take a lease of the Observatory buildings and part of the grounds for a period of five years, to enable the completion of the observational programme on which the Observatory has for some years been engaged, the determination of the proper motions of some 30,000 stars in the Kapteyn Areas. The Radcliffe Observatory will then be moved to South Africa. Its new site has not yet been finally selected, but it will be somewhere on the high central plateau, where the atmospheric conditions for astronomical work are second to none in the world.

LIKE the Radcliffe Library and the Radcliffe Infirmary, the Observatory was formed by the trustees of the estate of the famous physician, John Radcliffe (1650–1714), the first Radcliffe Observer being Thomas Hornsby (1733–1810), who was appointed in 1772 and under whose direction the observatory was erected and equipped at a cost of £28,000. The original instruments included two quadrants and a transit instrument, a zenith sector, an equatorial and a Dollond achromatic refractor, to which later on a Newtonian reflector by Herschel was added. Hornsby had succeeded Bradley as Savilian professor in 1763, and on the erection of the Observatory commenced a regular series of transit observations. At present the Observatory is the second oldest in the British Isles, and it has been the scene of the labours of many notable astronomers. Radcliffe was a fellow of Lincoln College, Oxford, and graduated as a bachelor of medicine in 1675. After practising for some years in the University, he removed to London and soon rose to the head of his profession, occupying much the same position that Sydenham did before him. Of strong common sense and independent views, he was very outspoken and sometimes rough, but of great liberality. He died at Carshalton, Surrey—according to his earliest biographer " a victim to the ingratitude of a thankless world and the fury of the gout "—but he was buried on Nov. 27, 1714, with much ceremony at St. Mary's, Oxford.

HEARTY congratulations were due this week to the veteran Sir James Crichton Browne, who, on Thursday last, celebrated his eighty-ninth birthday ; and also to Prof. Horace Lamb, who, on Wednesday last, attained his eightieth birthday. Sir James Crichton Browne was educated at Dumfries Academy, graduating thence, in the medical faculty, at the University of Edinburgh. For forty-seven years he was Lord Chancellor's Visitor in Lunacy. For many years he was treasurer of the Royal Institution. Despite his great age, his interest in the Royal Institution is maintained ; at the ensuing general meeting of members on Dec. 2, he will attend and make a presentation to a retiring officer of the staff whose services have covered half a century. Sir James Crichton Browne was elected into the Royal Society in 1883.

FOR upwards of forty-five years, Prof. Lamb has been recognised as the most prominent and successful worker in applied mathematics in Great Britain. In hydrodynamics he is a world-known authority. In the mathematical questions involved in the discussion of forces in aircraft, the action of screw-propellers, and stresses in aeroplane structure generally, his assistance has proved of high value. Awarded the Royal Society's Royal medal in 1902 for mathematical investigations, this was confirmed in ampler measure in 1923 by the allotment of the Copley medal. President of the British Association at the Southampton meeting of 1925, Prof. Lamb gave an address dealing in the main with geophysics. But some remarks of his on that occasion may be recalled as bearing on certain recent aspects of officialism in the State. "The habit", he said, " of sober and accurate analysis which scientific pursuits tend to promote is not always favourable to social and economic theories, which rest mainly on an emotional, if very national basis. There is, I think,

a certain dumb hostility, which, without venturing on open attack, looks coldly on scientific work except so far as it is directed to purposes of obvious and immediate practical utility." Prof. Lamb was elected into the Royal Society in 1884.

IT is satisfactory to learn that the structural alterations lately decided upon at the Royal Institution are going forward with a minimum of delay, so that the amenities enjoyed in normal times by the general body of members are within reasonable distance of renewal. Further, that these alterations are so designed that the aspects and qualities of the historic rooms and of the theatre are being carefully preserved. We trust, as do many who hold the Royal Institution in deep regard, that in the end that old-time atmosphere, that flavour of great personal traditions which here appeals so strongly, will be found not entirely disconnected with the efforts of rehabilitation. If any doubt existed as to the advisability of reconstructing the theatre, it has been removed during the dismantling of the structure by the disclosure of the dangerous condition of the woodwork. In the course of a century, dry-rot had obtained a hold in many parts.

THE financial problems arising from the various alterations to the Royal Institution are, of course, extremely onerous. Although those whom we may perhaps call the friends of the Royal Institution have generously responded to a first financial call entailed by the scheme, a balance of about £17,000 is still required. The Royal Institution with its laboratory, fine library, and rota of experimental and philosophical lectures, is something beyond a mere London society of persons interested in the movements and progress of science. In effect it is a bequeathment to posterity by Rumford, Davy, Faraday, Dewar, the repercussions of which are international. Accordingly strong hopes are entertained that the necessary sum will be forthcoming. Apart from physical science it is worth recalling that the Royal Institution in early days took a hand in the promotion of geology and mineralogy. By the year 1804 a museum of more than 3000 mineral specimens and fossils had been brought together, including a special collection of minerals formed by Davy. During the years 1805–7 Davy lectured occasionally on geology as well as chemistry, and he was one of those present at the meeting in Freemason's Tavern, Great Queen Street, on Nov. 13, 1807, when it was resolved to institute a Geological Society. Faraday became a member of the Geological Society in 1824.

IN his Croonian Lecture on "The Developmental History of the Primates", delivered to the Royal Society on Nov. 21, Prof. J. P. Hill gave an illuminating summary of his investigations, extending over many years, on the evolution of the placenta and the early phases of the embryo in the Primates. The results of this difficult and exacting work emerge from the complexities, which are so bewildering to all except a few specialists, as a lucid statement defining a series of facts of observation easily susceptible of confirmation. Hence the evidence provided by Prof. Hill's laborious researches should establish once for all the true relationships of the four groups into which he subdivides the Primates. Man and the anthropoid apes are included in the same group, which was derived from the stage revealed in monkeys, both of the Old and the New World. This Pithecoid stage is clearly an advance on the Tarsioid type of placentation, which is displayed in the solitary survivor of the group, the spectral tarsier. It is equally certain that the Tarsioid placentation was derived from a primitive Lemuroid type, which can be inferred from the common denominator of the diversely specialised forms found in the living lemurs, galagos, lorises, and indrisines. Prof. Hill has demonstrated that the Lemuroidea certainly belong to the order Primates, and that man is nearly related to the anthropoid apes, the common ancestors of which must have passed successively through both Tarsioid and Pithecoid stages in their descent from some pre-Tertiary Lemuroid. The evolutionary process of adaptive specialisation involves a speeding-up and an abbreviation of the developmental processes.

THE Huxley Memorial Lecture of the Royal Anthropological Institute was delivered by Baron Erland Nordenskiöld in the lecture theatre of the Royal Society, Burlington House, on Nov. 26. Baron Nordenskiöld chose as the subject of the address "The American Indian as Inventor", a subject on which his prolonged study of American technology and his journeys of anthropological exploration in Central and South America have made him peculiarly competent to speak. In his lecture he dealt with the question as to the extent to which we may suppose that the American Indians have independently invented many things entirely uninfluenced by the Old World. He gave numerous examples of inventions and discoveries that must necessarily be of original Indian conception, seeing that they were unknown in the Old World prior to the discovery of America. Among such he mentioned the use of poisonous manioc for food, tobacco and tobacco pipes, the rubber ball, rubber syringe, and the hammock; quinine, curare, and other poisons; the use of cayenne pepper in the preparation of a poison gas employed in siege warfare; the welding of copper; various kinds of musical instruments; calculating by means of knotted strings by the decimal system, and so forth. He asked whether it may not reasonably be supposed, seeing that the Indians discovered so much that was unknown in the Old World, with its variegated culture, that they may also have discovered various things that were known there. In the course of the lecture it was repeatedly emphasised that what was said did not constitute any conclusive evidence that there might not have been some pre-Columbian intercourse between the cultures of the Old and the New World. Even if there had been intercourse, it does not constitute proof that everything of common possession must necessarily derive from a common origin. At the close of the lecture the Huxley Memorial Medal of the Royal Anthropological Institute was presented to Baron Nordenskiöld by Prof. J. L. Myres, president of the Institute.

THE November issue of the *Realist* contains a stimulating article by Mr. J. B. S. Haldane upon the

place of science in western civilisation. Mr. Haldane's forceful style is always attractive, but when it is exercised upon so fruitful a topic as the present it shows to particular advantage. The main thesis of the article is that western civilisation has completely failed to integrate into its intellectual structure the scientific ideas that furnished its material structure. There are thus two alternatives before it. In the first place, scientific ideas may not be accepted by the ruling class, in which event Mr. Haldane foresees further wars, spiritual decay, and a drying-up of the flow of real invention. The second alternative is that a serious attempt will be made to incorporate scientific ideas, as well as scientific inventions, in our national and international life. If this attempt were made, and succeeded, it would do much to fill the emotional gap which is left " by the collapse of the religious picture of the universe ", for the scientific point of view is lofty enough to satisfy any of the aspirations of the human spirit. According to Mr. Haldane, Soviet Russia has chosen the second alternative. He says that there is " any amount " of research being done in Russia, and that there is an intense general interest in science. The children in the towns of Russia, he avers, learn a great deal more science than the corresponding children in England, and the scientific workers are relatively, though not absolutely, much better off than they are in Great Britain. While we agree with Mr. Haldane that western civilisation has far to go before it properly appreciates the true value of science, we cannot help contrasting his roseate account of Soviet Russia with the diametrically opposite estimate given by Mr. Lancelot Lawton a few pages further on in the same issue of the *Realist*.

DR. CHARLES SINGER also has an article in the November *Realist*, on the " Dark Age of Science ". After observing that science is a process and, like most processes, can be reversed, he states that, so far as science is concerned, the whole course of history presents no clearer division than that between the earlier Middle Ages or ' Dark Age ' and the later Middle Ages or ' Scholastic Age '. The critical event is the arrival of Arabian influence in the twelfth and thirteenth centuries. When in contact with a new medieval document, the first question that the historian of science asks himself is whether he can discern Arabian influence in it. If he can, the document is placed in the scholastic category ; if he cannot, in the Dark Age category. Dr. Singer exemplifies the characteristics of Dark Age ' science ' by reference to the " Handboc " of the monk Byrhtferth of the monastery at Ramsey. This was written half a century before the Norman conquest of England, and has recently been edited, with a translation, by Mr. S. J. Crawford. Byrhtferth was a good average Dark Age writer, and Dr. Singer condemns him and his contemporaries, referring to " the sophisticated childishness, the inane learning, and the humourless edificatory imbecility of the men of those times". His book is worth perusal by those who dwell in the light that science has since shed. The charge against the Church of having destroyed ancient science is, in Dr. Singer's opinion, unfounded, for there was practically nothing to destroy. When, in the sixteenth and seventeenth centuries, she did oppose independent thought, it was because the discoveries and theories of Copernicus, Giordano Bruno, and Galileo threatened to overthrow the doctrine—fundamental from the Church's point of view—of a finite universe.

THE relationship between biological phenomena and weather is of profound interest to the naturalist, and the " Report of the Phenological Observations in the British Isles from December 1927 to November 1928 ", published by the Royal Meteorological Society, supplies a wonderful assortment of data for consideration and speculation. The labour of collecting and tabulating the notes from the 467 stations now in being must be enormous, and were it not that generalised results are shown, the tables and individual records are not such as the general reader can peruse with any satisfaction to himself. A comparison of the excellent charts brings out some interesting results. The lines throughout the British Isles (migrant isophenes) interpreting the equal arrival dates of twenty selected migrant birds, show that the earliest arrivals occur on the south-east coast of England, that coastal arrivals precede inland arrivals, the coastal dates up to the Wash-Mersey line being some three days later than the south coast dates, to the Tyne-Solway line six days later, and to the north of Aberdeenshire nine to twelve days later. It is a striking fact that there appears to be some correlation between the floral isophenes and the migrant isophenes, and this, since it connects local conditions of flowering and the appearance of birds which have set out from distant places, seems to indicate the influence of very far-reaching weather conditions.

DURING the four weeks ending Oct. 17 there has been a remarkable increase of seismic activity in the island of Hawaii. The numbers of earthquakes registered at the Kilauea Observatory suddenly rose from 9 during the week ending Sept. 18 to 221, 244, 129, and 97 during the succeeding weeks, the origins of the shocks being concentrated below the Hualalai Volcano, a mountain 8269 feet high on the west side of Hawaii. Two strong earthquakes of intensity 9 (Rossi-Forel scale) occurred on Sept. 25 and Oct. 5. Though, after the latter date, there was a marked decrease in strength and frequency, the occurrence of this tremor-storm suggests that the Mauna Loa lava column, which has sent out its flows from the south-west rift of the mountain during the last twenty-five years, is now moving underground towards Hualalai. The decline in activity may imply that the mountain fissures are more open and the lava outburst near at hand.

IN telephony many attempts have been made to increase the speed of communication between automatic exchanges and manual exchanges, and specially between subscribers having automatic telephones and those connected with rural exchanges. It is stated in a recent issue of the *Times* (Nov. 9), that the Bell Telephone Laboratories have made a considerable step in this direction and have given a public demonstration of their new method. They use talking films to

assist in the operation of automatic telephones. The device consists of ten films, one for each number from zero to nine. These are recorded by an operator specially selected for her telephone voice. The films are wound on drums installed in the exchange. The dialling by the subscriber of the number required automatically releases the films, which revolve and call out the number required to the exchange operator. It is expected that many of these film-calling devices will be in practical use in a few weeks' time. A demonstration was also given by the Bell Laboratories of an improved means for ensuring the secrecy of radio-telephonic conversations. The method adopted is to 'scramble' the words of the message. In the course of the transmission the high frequencies are changed to low frequencies and vice versa. The frequencies are then inverted and the conversation becomes intelligible. Before the retranslation, the sounds are completely unintelligible.

AT the Institution of Electrical Engineers, on Nov. 21, three papers were read dealing with the low temperature carbonisation of coal with special reference to its combination with the production of electricity. One of the papers described English practice, another American practice, and the third German practice. Whilst most other countries have hydro-electric power to fall back upon, the amount of power available from this source in Britain is never likely to provide more than about one-twentieth of our total power requirements. It is suggested that the power plant of the future will take in coal as its raw material, but will deliver, in addition to electricity, motor spirit, fuel oil, creosote, pitch, and other derivatives of coal tar. The present coal distillation plant at Dunston-on-Tyne produces from one ton of Northumberland small coal, 16 gallons of tar oils, and $\frac{3}{4}$ ton of semi-coke. It is stated that a wide and promising field of research in this direction has not yet been explored, although the first step has been taken. It is most important that coal, the valuable national asset of Britain, should be fully utilised.

IN America great interest is taken in the carbonisation of fuel, and the trend of progress is towards the co-operation of the electric companies with public service companies supplying gas for domestic and industrial purposes. Germany's coal industry is characterised by the competition between pit coal and brown coal. The pit coal is similar to that used in England, whilst the brown coal is of very inferior value until it has undergone suitable treatment. The production of brown coal, of which there is an almost unlimited supply, already amounts to 170 million tons a year. The cost of pit coal, however, will probably increase owing to the increasing depths of the pits. A large combination steam and brown coal carbonisation plant is now in operation. Germany is looking forward to the combining of carbonisation plants, power stations, and gas works.

A NUMBER of spectacular experiments involving the use of sound-films, photoelectric cells, and reproducing apparatus were demonstrated by Mr. J. B. Taylor, of the General Electric Co., Schenectady, in a lecture given on Nov. 6 to the New York Electrical Society. An image of the sound track of the film after projection on to the screen was used to actuate a loud speaker through the medium of a photo-electric cell. Various distortions of reproduced speech were then demonstrated by running the film at speeds up to three times the normal, by running the film in the reverse direction, and by increasing or decreasing the width and position of the slit, thus allowing selected and restricted portions of the sound track to act on the cell. The rapid fluctuations in intensity of apparently constant sources of light were also demonstrated as sounds by allowing them to illuminate the photoelectric cell of the sound reproducing apparatus.

IT is well known that the principles governing successful communication over long distances on land and sea have their origin in optical, acoustic, and mechanical methods which were used in primitive times. Through revolutions, wars, and reformations the art of signalling by these means can be traced to the beginning of the nineteenth century, when it attained its highest perfection under Claude Chappe, the first administrative telegraph engineer in France. Mr. Rollo Appleyard, in *Electrical Communication* for October, rightly includes him in his biographies of the pioneers of electric signalling. Chappe, who was born in 1763 and died in 1805, endeavoured to replace acoustic signals by electric signals. At that time, however, the insuperable difficulty was how to insulate the wire. Chappe was educated for the Church, but when the Revolution came he devoted himself to the Republic. From 1793 to the end of his life he did valuable public service, semaphore lines operating on his method and with his code connecting Paris with many towns in France.

CHAPPE'S only recompense as an inventor was the satisfaction of having served his country. He did not escape cruel annoyance by those who claimed to have anticipated his successful devices. In 1804, Napoleon demanded the immediate establishment of a telegraph service between Paris and Milan through Lyons. The work proved too heavy for him and shortened his life. Ultimately there were 58 semaphore stations between Paris and Lyons. Trees which interfered with the line of vision were cut down and their owners indemnified. Chappe was fully aware of the extent to which the general principles of his devices had been praised by the ancients. The value of his work lay in the adaptation of these principles to the needs of his time. His mechanism was designed to secure the greatest visibility, strength, lightness, durability, and ease of operation, and his successful methods were a great boon to several European countries until the invention of the electric telegraph by Wheatstone in 1837 made some of them antiquated.

AT a meeting of the Newcomen Society held on Nov. 20, Mr. Rhys Jenkins read a paper on "The Art of Water Drawing", the title being taken from a work published in 1660 apparently written by one R. D'Acres, whose name is attached to the preface. The book is extremely rare, and in view of the interest-

ing way the author treated his subject, the Society proposes to reprint it as one of its "Extra Publications". A striking feature of the book is the systematic way in which the pumping machine is analysed into prime mover, transmitting mechanism, and operating member, while D'Acres gives evidence that he understands the action of the pressure of the atmosphere in forcing water into a vessel containing a partial vacuum. He goes on to suggest, indeed, the use of fire for the raising of water, and describes an apparatus into which water can be drawn through the cooling of hot gases within it. Whether he made such an apparatus is not known. Mr. Jenkins gave some interesting information regarding the use of bucket gins, that is, the chain of buckets or chain of pots once in common use in Great Britain, suction pumps, force pumps, and other appliances of Tudor and Stuart times, and referred to some of the earliest examples. According to the "Oxford English Dictionary", no trace of the name 'pump' occurs before the fifteenth century, for though remains of Roman pumps have been found, such things went out of use with the coming of the Saxons. During the meeting, it was announced that Mr. L. St. L. Pendred has consented to continue as president for a second year, and that the Society now has 248 individual members, besides 57 institutions which subscribe as members.

MR. ERIC MACLAGAN, director and secretary of the Victoria and Albert Museum, South Kensington, has been elected an honorary member of the Yorkshire Philosophical Society.

FURTHER correspondence concerning the appearance of the comma butterfly in England has reached us (see also NATURE, Oct. 26, p. 653, and Nov. 16, p. 770). Mr. E. J. Machin records its capture at Tettenhall, South Staffordshire, on Oct. 18 last, and Mr. R. L. Williams states that a specimen was taken in the grounds of the Biological Field Station of the Imperial College of Science, Slough, Bucks, on Sept. 24.

THE Principal Trustees of the British Museum have appointed Mr. J. Ramsbottom, at present deputy keeper in the Department of Botany, to be keeper of the Department on the retirement of Dr. A. B. Rendle on Jan. 19 next. Mr. G. J. Arrow has been appointed deputy keeper in the Department of Entomology.

AT the annual general meeting held on Nov. 14 of the London Mathematical Society, the following officers were elected:—*President*: Prof. S. Chapman; *Vice-Presidents*: Prof. W. E. H. Berwick, Prof. P. J. Daniell, and Prof. E. H. Neville; *Treasurer*: Dr. A. E. Western; *Librarian*: Prof. H. Hilton; *Secretaries*: Prof. G. N. Watson and Mr. F. P. White; *New Members of Council*: Mr. T. W. Chaundy, Prof. G. H. Hardy, Prof. H. Levy, and Prof. L. J. Mordell.

THE Williams Prize of the Iron and Steel Institute, of the value of 100 guineas, has this year been awarded by the Council to Mr. William E. Simons, assistant blast-furnace manager at the Cardiff Works of Messrs. Guest, Keen, and Nettlefolds, Ltd., in consideration of his paper on "The A.I.B. Sinter Plant at the Works of Guest, Keen, and Nettlefolds, Limited," which he presented at the last annual meeting of the Institute in London.

AT the annual general meeting of the University of Durham Philosophical Society, held on Oct. 31, the following officers were elected:—*President*: The Hon. Sir Charles A. Parsons; *Vice-Presidents*: Prof. Masson, Mr. Wilfred Hall, Sir William Marris, Dr. Morrow, Dr. Smythe, Prof. Harrison; *Hon. Secretary*: Mr. W. M. Madgin, Armstrong College, Newcastle-upon-Tyne; *Hon. Treasurer*: J. W. Bullerwell, Armstrong College, Newcastle-upon-Tyne.

ON Oct. 1, Sir Frederic G. Kenyon opened at Hull the Mortimer Collection of Prehistoric Antiquities, which was presented to the Corporation by Col. G. H. Clarke, and has now been given a permanent home in the Old Art Gallery of the City Hall. There are few museums, Sir Frederic said, which put the people so closely in touch with prehistoric man as the Mortimer Museum. The objects are clearly recorded and admirably displayed. Some idea of the extent and scientific value of the collection may be gathered from the fact that Mr. Mortimer excavated about 350 burial mounds, from the Bronze Age to Roman and Saxon times, and preserved every object found in them. In addition, there are many Neolithic objects found unassociated with burials in various parts of the world.

THE Department of Zoology of the British Museum (Natural History) has recently received a fine example of the common porcupine (*Hystrix cristata*) mounted in a defensive attitude with its spines erected, from the trustees of the Rowland Ward Bequest; while Mr. C. D. Soar has presented to the Department a collection of nearly 600 slides of microscopic preparations of water-mites, forming the material described in the standard monograph, "British Hydracarina", by Mr. Soar and Mr. Williamson, published by the Ray Society (1925–29, 3 vols.). Through the generosity of Mrs. M. E. Eaton, the Department of Entomology has received the collection of Psychodidæ (moth-flies) formed by her late husband, the Rev. A. E. Eaton, and including more than 1800 pinned specimens and about 200 microscope slides. It is probable that the Eaton collection is the largest and most important in existence, including as it does, in addition to a complete series of the known British species, much material from Switzerland, Algeria, Madeira, the Canary Islands, and elsewhere. It is hoped that it may be possible to publish some parts of Mr. Eaton's manuscript notes on the group. A recent addition to the Department of Geology is a cast and enlarged model of the tooth of the fossil man *Sinanthropus pekinensis* from the Pleistocene of China. Many specimens of minerals and rocks recently collected in Northern Rhodesia and South-west Africa have been added to the mineral collection.

A CATALOGUE (No. 10) of some 500 second-hand books relating to botany and zoology has been received from Mr. J. H. Knowles, 92 Solon Road, S.W.2.

WE have received from Messrs. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, a copy of their

latest catalogue of books relating to medicine and allied sciences.

MESSRS. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, have added to their interesting series of catalogues No. 519, consisting of nearly 600 titles of books, maps, views, and MSS. concerning the West Indies.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A demonstrator in civil and mechanical engineering in the Department of Engineering of the University of Leeds—The Registrar, The University, Leeds (Dec. 2). A clinical assistant in the Department of Physio-Therapy of St. George's Hospital—The Dean of the Medical School, St. George's Hospital, S.W.1 (Dec. 7). A lecturer in physics at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (Dec. 10). A woman lecturer in geography at the Leeds Training College—The Principal, Training College, Leeds (Dec. 10). A principal of the Norwich Technical College—The Secretary of Education, 41 St. Giles Street, Norwich (Dec. 10). A director of the Marine Trades School, Suez, under the Egyptian Ministry of Education—The Under Secretary of State, Ministry of Education, Cairo (Dec. 10). A glass blower in the Department of Chemistry of the University of Cape Town—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Dec. 11). A petroleum technologist to the Government of Trinidad—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, S.W.1 (Dec. 20). A professor of social biology at the London School of Economics—The Academic Registrar, University of London, South Kensington, S.W.7 (Jan. 23). A Martin White professor of sociology at the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 24). A head of the Department of Mechanical and Structural Engineering and Building of the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A lecturer in mathematics and geography at St. Gabriel's Training College for Women—Miss K. T. Stephenson, St. Gabriel's College, Cormont Road, Camberwell, S.E.5. A laboratory assistant in the soil chemistry laboratories of the Agricultural Research Station, Amani, Tanganyika Territory—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/1797). A lecturer in botany in the University of Reading—The Registrar, The University, Reading. Heads of the pathological and botany divisions of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2/4 Idol Lane, Eastcheap, E.C.3.

Our Astronomical Column.

Changes on Jupiter.—The planet Jupiter will be in opposition to the sun on Dec. 3, and promises to exhibit some very interesting phenomena to observers. Mr. A. Stanley Williams, Rev. T. E. R. Phillips, and others have reported the appearance of a long stream of dark spots in the region immediately south of the north temperate belt of the planet. On Nov. 16 the spots extended over about half the circumference, for Mr. Phillips found that they occupied 5 hours in crossing the central meridian. This outburst of spots has appeared in the same latitude and presents a similar aspect to that shown by a remarkable train of spots which attracted much attention in October and November 1880. The latter objects gave a rotation period of $9^h\ 48^m$ and formed a new dusky belt on the planet in 32 days. They were among the swiftest markings ever detected on the Jovian surface. The present revival of similar details is very suggestive of repetition, for the spots at present visible are travelling with great rapidity of movement and complete a rotation in about $9^h\ 49^m$. They are being attentively watched in order to determine whether or not they become transformed into a new belt as occurred with the markings of 1880.

The Binary Star 70 Ophiuchi.—It has long been known that the discordances between theory and observation in the distances and position angles of this star are of a somewhat systematic nature ; some of the orbit computers have considered that there was evidence of a third unseen component disturbing the motion of the others ; an alternative explanation was that the discordances arose from systematic errors in the observations, depending on the inclination to the vertical of the line joining the stars. It is known that some observers have personal errors of this nature, and R. Tschilschke examines in *Astr. Nach.*, No. 5664, whether the discordances can be explained in this way. He concludes in favour of the existence of a third mass from the fact that the discordances have a different period from the period of revolution of the visible pair ; he finds 89·09 years for this, but about 64 years for the discordance. He concludes also that the node shows a yearly change of some 2°, indicating that the third body moves in a plane different from that of the visible system.

The Star-cloud in Scutum.—*Lick Bulletin*, No. 416, consists of an examination by C. J. Krieger of the distance and depth in the line of sight of the galactic star-cloud in Scutum (now generally included in Aquila). The centre of the cloud is at about R.A. $18^h\ 43^m$, S. Decl. 7·6° (equinox of 1900). The spectral types of the brighter stars were obtained by slitless spectrograms ; the photographic magnitudes by comparisons with the north polar sequence ; the colour indices by photographs with colour filters. The cloud is approximately 6° by 8° in angular area ; its mean distance is determined as 2800 parsecs, which makes its mean diameter in a direction perpendicular to the line of sight 350 parsecs ; the depth in the line of sight appears to be greater, being between 500 and 1000 parsecs. The relative luminosities of the different spectral types are the same as in the neighbourhood of the sun, but the density of distribution of dwarf stars is considerably greater. There is concluded to be a region of low star density between the solar cluster and the Scutum Cloud. Other estimates of the distance of the cloud are : Seares, 7000 parsecs ; Shapley, 4000 to 6000 parsecs ; Kreiken, 1500 parsecs ; Malmquist, 3400 parsecs. The mean is 4200 parsecs, or 1·5 times Krieger's estimate. The study of the distance of these galactic condensations is of interest for comparison between them and the condensations in the spiral nebulæ.

Research Items.

Mice and Evolution.—Following a summary of recent results of the irradiation of animals by X-rays and its effect upon inheritance of characters, N. Dobrovolskaïa-Zavadskaïa has discussed his own experiments upon 35 breeding mice (*Biol. Rev. and Biol. Proc. Cambridge Phil. Soc.*, vol. 4, October 1929, p. 327). In a progeny numbering about 3000, only two mutations were discovered, and these, having already been found apart from irradiation, are regarded as manifestations of pre-existing latent states brought to light under the influence of the rays. The rays can scarcely, therefore, be looked upon as a real cause of mutations, as has been alleged. On the results of these relatively few experiments, the author has the temerity to base a theory of evolution, a hypothesis of stable species with single changeable individuals, which are the source of new forms. This hypothesis conceives evolution to be based on three foundations: (1) Stability of existing species as the expression of the conservative principle of life; (2) variability of single individuals as the manifestation of the creative power in Nature; and (3) natural selection as the sifting out of the adapted species. We cannot comment on these conclusions in this note, but on general grounds we deprecate the building up of wide theories upon artificial experiments without any reference to the course of events in Nature. Although species are of the essence of the theory, the species of mouse experimented with here is not even named.

Catgut and its Sterilisation.—With the exception of antiseptic treatment, probably no procedure has advanced the practice of surgery more than the use of the ligature for tying the blood-vessels and controlling hæmorrhage. Many substances have been employed for the purpose, but catgut is usually the material to be preferred. Catgut for surgical use should be sterile in the sense of being free from any bacterial contamination, yet flexible, strong, and absorbable in the tissues. The practical problems involved in producing such a material are the subject of a report by W. Bulloch, L. H. Lampitt, and J. H. Bushill, issued by the Medical Research Council (*Special Report Series*, No. 138; London: H.M. Stationery Office, 4*s*. net). Prof. Bulloch contributes what must be the most complete modern account of the history and literature of the whole subject, as well as the results of thousands of sterility tests and experiments on methods of sterilising. Dr. Lampitt and Mr. Bushill deal with the physical and chemical properties of the sheep's intestine (from which 'catgut' is made) and its manufacture into sterile ligatures for surgical use. Prof. Bulloch finds that much commercial surgical catgut is not sterile, and that many of the sterilising processes recommended are inefficient. It is of interest that the last method devised by Lord Lister, who studied the subject for forty years, which consists in the use of chromium sulphate and mercuric chloride, yields a sterile product. Prof. Bulloch finds that a 1 per cent aqueous solution of iodine and potassium iodide will infallibly sterilise the most contaminated catgut if applied for not less than eight days, and is the best agent to employ on a commercial scale. Messrs. Lampitt and Bushill show that the iodine process yields a satisfactory ligature provided certain conditions are observed and precautions taken during manufacture.

Development of Mosquito Larvæ.—Dr. Malcolm E. MacGregor (*Parasitology*, vol. 21, 1929) has described observations on the significance of the hydrogen ion concentration in the development of mosquito larvæ, especially those of *Ædes argenteus*. By gradually eliminating one and another of the interacting factors he has been able to demonstrate (*a*) that if the *p*H of the normal environment is changed the development of the larvæ is adversely affected; (*b*) that under bacteriologically sterile conditions the foregoing statement is no longer true; and (*c*) that consequently the acid or alkaline reaction of the medium, within ordinary limits, has no direct effect upon the development of the larvæ. An alteration in the *p*H often brings about a change in the biological group associations and the abnormal dominance of factors unfavourable to a particular species of larvæ. The larvæ of certain species show a restriction to waters exhibiting a *p*H index within a definite short range, and hence the *p*H index is often a trustworthy indication as to whether the chemical and biological group associations will favour or preclude successful development of such larvæ. The author states that of the different artificial food stuffs nothing has been found to suit the larvæ of *Ædes argenteus* so well as bread, and he describes the technique for the production of successful cultures of larvæ and pupæ under bacteriologically sterile conditions. The phase of 'suspended development' of the larvæ of many species of mosquitoes is found to have its probable explanation in the temporary or complete disappearance of micro-organisms on which the conversion of the organic materials of the environment to a suitable larvæ diet depends.

Parasitic Roundworms in Sheep.—The Ministry of Agriculture and Fisheries has recently issued two clearly written leaflets on parasitic roundworms in sheep. The first (No. 75) gives an account of the twisted wire worm (*Hæmonchus contortus*) which occurs in the fourth stomach of the sheep, and the second (No. 304) deals with the common lung worms of cattle, sheep, and goats, causing 'husk' or 'hoose'. The life-history of the respective worms so far as it is known is concisely described, and will undoubtedly "assist the direction of intelligent effort towards suitable measures of control". These measures and curative treatment are briefly described.

Trypanorhynchid Cestodes from Ceylon and India.—The first part of a monograph by Dr. T. Southwell on Cestodes of the order Trypanorhyncha from Ceylon and India is published in *Spolia Zeylanica*, vol. 15, part 3, 1929. An extensive historical survey of the literature of the order is followed by the author's proposed classification into three families with six certain genera and one of uncertain position, and by a description of each of the species. A list is given of the species—about three dozen—recorded from India and Ceylon and of their respective hosts. A note is added on larval cestodes collected in large numbers from the umbrella of a rhizostomous medusa in the Chilha Lake. At the anterior extremity of the larva is a deep pit the base of which—where the head or scolex would later develop—is thickened. These are plerocercoid larvæ but are not identifiable further. Dr. Southwell states that no cestode larvæ have been previously recorded from medusæ.

A Four-Rayed Clypeaster.—Mr. Iwao Taki describes an unusual abnormality in this specimen of *Clypeaster japonicus* ("Note on a 4-rayed Specimen of *Clypeaster japonicus* Döderlein". *Memoirs of the College of Science*, Kyoto Imperial University, Series B, vol. 4, No. 2, article 6, 1929.) It was found on the shore close to the Seto Marine Biological Laboratory, Seto, Prov. Kii, after a heavy storm. Several normal

individuals were obtained at the same time. Compared with these latter the abnormal specimen, which is immature, has a much rounder outline, the test is higher, the number of ambulacral pore-pairs smaller, and the outline of the petals oval with an obtuse distal part. The four rays are repeated in the madreporite, which is nearly square with only four genital pores, situated at the four corners. One of the petals is open showing it to be the anterior. The remaining three, therefore, represent the other four rays of a normal specimen. From the number of pore-pairs it is deduced that one of the posterior petals is missing, and that the tetramerism is brought about by the abortion of the right posterior ambulacrum and adjacent interambulacra.

Nets for Plankton Research.—In a recent publication by the International Council for the Exploration of the Sea ("Vergleich der Fangfähigkeit verschiedener Modelle von Plankton-netzen". *Rapports et Procès-Verbaux des Réunions*, vol. 69, September 1929 (København: Andr. Fred. Høst et Fils) Cl. Künne gives the results of some quantitative tests which have been made with three types of nets, Hensen's egg-net, the Nansen net, and the standard net of the International Council. He finds that while the Nansen net and the Hensen net are rather similar in their catching powers, the former catching about 90 per cent as much as the latter, the standard net, on the other hand, falls far short in efficiency, catching only one-tenth of the material that the Hensen net does. Moreover, this is not due so much to the lesser dimensions of the opening of the standard net, but rather to its construction. It seems probable that the netting inserted at the front tends to constrict the virtual opening of the net where it joins the silk, and the throttling rope may also help in this at times. The question is an important one and should be settled now that there is a tendency more and more to standardisation of method in order that results may be comparable. The author favours the Hensen net for its convenience in sea work, in spite of its cumbrous size.

Nitrogen Metabolism of Virus Diseased Plants.—The nitrogen metabolism of healthy and spiked sandal leaves has been studied by N. Narasimhamurthy and M. Sreenivasaya, and their results have been published as Part 6 of the "Contributions to the Study of Spike-disease of Sandal (*Santalum album* Linn.) in Vol. 12 A, Part 10, of the *Journal of the Indian Institute of Science*, pp. 153-163. They report a greater content of total nitrogen (on a dry weight basis) in spiked leaves than in healthy leaves where a leguminous host is absent, whilst little difference can be detected when the latter symbiont is present. There is, however, in all cases an increase in total water-soluble nitrogen, basic nitrogen, and total amino nitrogen, and a decrease in the nitrate nitrogen in the diseased leaves, when compared with healthy leaves, relative to either dry weight or to total nitrogen. Comparisons are drawn with the nitrogen contents of several plants attacked with virus diseases which usually show no decrease in total nitrogen content as a result of the disease.

Industrial Development of Saskatchewan.—The province of Saskatchewan in the Dominion of Canada is chiefly known as a great wheat-producing area, but the development of its natural resources in other directions is proceeding apace, and it is apparent that before very long there will be an industrial activity corresponding in many respects to that of the provinces of eastern Canada. A report issued by the Natural Resources Division of the Saskatchewan Department of Railways, Labour, and Industries, for the fiscal year ended April 30, 1929, shows that during the past twelve months much attention has been given to the establishment of the lignite briquetting industry near Estevan, and to mineral development in that large area of Saskatchewan which lies within the boundary of the two million square mile Pre-Cambrian Shield. Mention is made in the report of the exploitation of the Province's non-metallic mineral resources, etc., its clays, sodium sulphate deposits, and volcanic ash, special attention being given to the marketing of sodium sulphate, the importance of which to the Canadian pulp and paper industry is considerable.

The Eruptions of Mayon Volcano.—In *The Philippine Journal of Science* for September last, L. A. Faustino describes Mayon Volcano and its eruptions, with special reference to the great outburst that took place last year. The volcano is a cinder cone with venticular lava-flows, and its profile follows very closely the hyperbolic sine curve discussed many years ago by Becker. Surface indications point to only one orifice, and if there have in the past been subordinate openings, they have since been hidden. None appeared in 1928. The original vent broke through a Tertiary basement in late Tertiary or early Quaternary time, and Mayon is to-day the most active cone in the Philippines. The ejected materials are of porphyritic basaltic composition and they have repeatedly smoothed the irregularities caused by erosion and weathering, thus maintaining the almost perfect symmetry and form of the cone. Since the destructive eruption of 1814, twenty-eight well-defined eruptions have been recorded, the longest period of relative quiescence being from 1900 to 1928. The eruptions can be described in terms of the sequence recognised by Perret in his well-known description of the Vesuvius eruption of 1906. In the case of Mayon, the luminous, *liquid lava* phase is of shorter duration than at Vesuvius; the intermediate, *gas* phase, characterised by vapours and gases with but little ash, is longer; and the dark, *ash* phase is marked as usual by a preponderance of ejected ashes.

Late Cretaceous and Tertiary of New Zealand.—In his presidential address to the Geological Section of the Fourth Science Congress of New Zealand, Dr. J. Henderson gave a detailed series of correlations of the Tertiary and late Cretaceous deposits for seven characteristic areas of New Zealand (*Trans. and Proc. N.Z. Inst.*, **60**, pp. 271-299; 1929). The strata are divided into three groups on diastrophic grounds. The first, following the Hokanui deformations, when New Zealand was more extensive than now and diversified with a great chain of mountains of which the present axial highlands are the roots, extended from the Albian to the close of the Eocene. Widespread movements then occurred, and basic rocks were erupted in many districts. The resulting elevation, however, was not great, and base-levelling reached its climax during the succeeding Ototaran or Oligocene period. In the Miocene, the andesitic lavas of Auckland and Hauraki were poured out. These seem to have relieved the crustal stresses in part, for the post-Ototaran movements are found to be more pronounced in the South Island, where volcanic outbursts were less active. During the Pliocene, the Kaikoura movements reached their climacteric. Since then the Castlecliff beds and their correlatives have been laid down, and the basaltic vents of Whangaroa have continued intermittently. The paroxysmal rhyolitic outbursts of the Rotorua-Taupo region began a little later than the first emissions of basalt. The published address contains valuable correlation tables and a full bibliography.

Crystal Structure of Ice.—An elaborate investigation of the crystal structure of ice, now of importance in many connexions, is described by Dr. W. H. Barnes in the November number of the *Proceedings of the Royal Society* (pp. 670-693). The older data for this are conflicting, and even now the possibility cannot be ruled out that, quite apart from high pressure modifications, different forms may exist under slightly different conditions. Dr. Barnes's results, however, which are based upon the interpretation of X-ray diffraction photographs taken by various methods at the Davy-Faraday Research Laboratory, show that the space group in the specimens studied by him was one of the two known as D_{6h}^4 (dihexagonal bipyramidal) and D_{3h}^4 (ditrigonal bipyramidal), with the probability in favour of the former. Photographs taken by the powder method also failed to reveal any change in structure between the temperatures of standard melting ice and of liquid air. Four molecules go to build up each unit cell, and it is probable that the lattice is ionic.

Melting-point of Palladium.—The highest standard point in the thermometric scale which can be measured conveniently with the gas thermometer is the melting-point of gold, 1063° C. Above this, recourse is usually made to radiation thermometry, with for technical purposes an agreed value for the radiation constant (c_2). It is, however, useful to have other higher fixed points, and of these the most important is the melting-point of palladium. One determination of this was reported in the *Bureau of Standards Journal of Research* for May of this year, yielding the value 1554°. A second determination, made at the National Physical Laboratory by F. H. Schofield, is described in the *Proceedings of the Royal Society* for October, and gives the temperature as 1555°. Older determinations, made at the Physikalisch-Technische Reichsanstalt in 1919 (1556°), and at the Nela Laboratories in 1920 (1557°), are also in remarkably good agreement with the new numbers, and it thus seems probable that the agreed value of 1555° which has been taken as the melting-point for the purposes of the International Temperature Scale cannot be in error by more than 2°. It is an interesting fact that Prof. Callendar obtained a value only five degrees below this in 1899, working with a resistance thermometer of platinum, and extrapolating from the boiling-point of sulphur.

Measurement of Radioactivity.—The new electrical counter for α-particles and β-particles which was described by Prof. Geiger and Dr. W. Müller last year is so extremely sensitive to weak radiation that it could be used immediately to demonstrate the radioactivity of potassium, and has since been applied to the study of the cosmic rays. An investigation of its utility in the measurement of radium preparations has now been made at Prof. Geiger's instigation, and is described by H. Neufeldt in the issue of the *Physikalische Zeitschrift* for Aug. 15. The counter employed was of special design, and could, if desired, hold the radioactive preparation internally, the strength of the latter being measured by the secondary β-rays produced in the counter by the γ-radiation. Quantities of radioactive material equivalent to 10^{-6} mgm. radium could be measured in this way, as compared with about 10^{-3} mgm. with the most refined of the older methods. The precision of the measurements was about ten per cent, and the only important disadvantage inherent in the use of the instrument appears to be the long time—of the order of several hours—required to obtain sufficient auxiliary data to allow for the large number of particles of uncontrollable origin which are recorded by it, due very largely to the cosmic rays and the radioactivity of the material of the counter itself.

Viscosity of Solutions.—Although much experimental work on the effect of concentration on the viscosity of solutions has been carried out, it has been found difficult to represent the results by means of equations. In the October number of the *Journal of the American Chemical Society*, G. Jones and M. Dole describe some very accurate measurements of the viscosities of barium chloride solutions at 25° over a range of concentration of 0·005 to 1·0 molal. They find that the fluidity (1/viscosity) can be represented by an equation of the form $\phi = 1 + A\sqrt{c} + Bc$, which also fits other data with proper values of A and B. The term in $\sqrt{c}$ was suggested by the Debye and Hückel formula for electrolytes, and since A is always negative for electrolytes it is suggested that it represents the 'stiffening effect' on the solution of the electric forces of the ion atmosphere. For non-electrolytes A is zero. The value of B may be positive or negative.

The Active Principles of Pyrethrum Flowers.—The use of pyrethrum flowers, or an extract in the form of liquid insecticides, has increased considerably during the last five years, and some method of determining the amount of active principles in them has been required. In 1916, Staudinger and Ruzicka found that the two active principles of pyrethrum flowers were pyrethrin-I and pyrethrin-II, which were shown to be esters of a ketone-alcohol, pyrethrolon, with two acids, chrysanthemum monocarboxylic acid and chrysanthemum dicarboxylic acid methyl ester, to which they were able to attribute structural formulæ. In the October number of the *Journal of the American Chemical Society*, Gnadinger and Corl describe the isolation of pure pyrethrin-I and -II from Japanese pyrethrum flowers. They then worked out a method for the determination of these principles in the flowers by means of the reducing action on alkaline copper solution as compared with that of dextrose, and in this way were able to use much smaller quantities of material than were required in previous methods. The percentages found ranged from 0·40 to 1·21.

A Novel Evaporating Plant.—In the *Chemiker-Zeitung* for Oct. 16 is described a novel form of evaporating plant for which many advantages over other types are claimed. The principle involved is the distribution of the liquid into extremely thin layers, which are allowed to flow over funnel-shaped heating surfaces. The time required for the vaporisation of a given bulk of liquid is thus enormously reduced and the vapours can be removed rapidly without encountering the resistance of a column of liquid. The process is continuous, and since the liquid is also kept constantly in motion, there is no danger of superheating, foaming, or bumping. The heating units can be built up into columns of varying heights according to the degree of concentration of liquid required, and by means of separate steam-pipes they may be heated to different temperatures, so that when the evaporator is used for the distillation of oils a preliminary separation into fractions is effected. Fractionation may be completed by combining the evaporator with suitable dephlegmators and condensers. The apparatus is also well adapted for the concentration of solutions in which prolonged heating is apt to induce chemical decomposition; when once regulated for a particular operation, very little supervision is needed. The efficiency of the evaporator may be judged from the fact that 80-90 kilograms of water can be evaporated per square metre of heating surface in one hour without using a vacuum pump. The apparatus is patented and manufactured by Messrs. Zahn and Co., Ltd., of Berlin.

Fuel Research.[1]

THE Report of the Fuel Research Board for the year ended Mar. 31, 1929, is remarkable for its range of subject matter, and it is only by selective treatment that a short notice like this can be made anything more than an enumeration of its contents.

The first part of the report, by Sir Richard Threlfall, the chairman, does not limit itself to an account of the activities of the Board, but deals also with other happenings in the world of fuel which may be regarded as relevant. The opening sentence states a wholesome truth which cannot be too strongly emphasised in these days, when the pursuit of what is known as rationalisation may lead to over-centralisation if it is not carried out with care, discrimination, and sober judgment. The sentence proclaims the difficulty (and might have said impossibility) of one research organisation dealing adequately with the many and complicated problems involved in the study of the coal resources of Britain and their utilisation, and welcomes the increasing attention given to fuel research, both by individual firms and by industrial organisations. Notice is also given to a particular recommendation by the National Fuel and Power Committee, which is not content with the prosecution of research alone, but insists upon the necessity for the application of the results of research and the consequent necessity of employment on the executive side of industry of more men trained as fuel technologists.

Another recommendation of the National Fuel and Power Committee is noted, that the thermal system of charging for gas (introduced by the Gas Regulation Act of 1920, on the recommendation of the Fuel Research Board) should be regarded as having proved its value, and be made compulsory, except for very small undertakings. This recommendation has been embodied in the Gas Undertakings Act, 1929.

The physical and chemical survey of the national coal resources is reported upon as having progressed steadily, and with the appointing of a committee to deal with the South Wales area, the organisation now covers coalfields producing 85 per cent of the coal raised in Great Britain. There is so much that might be done on such a survey, with its many possible ramifications indicated in the report, that a wide vista of usefulness is opened out for the Fuel Research Board, if it is to deal adequately with this part of its work. The survey once begun leads naturally to the operations of other committees (such as the Coke Research Committee, formed at the instigation of the National Federation of Iron and Steel Manufacturers), which deals with the properties of coal mined in certain areas for various industrial uses.

All this has led to a realisation of how comparatively little is known even to-day on many of the most fundamental and elementary things connected with coal and its carbonisation; and the Fuel Research Board is assisting workers at the universities in their endeavours to extend and strengthen the scientific foundations on which the structure of the fuel industries must be based.

Quite topical is the reference to the use of pulverised fuel, both ashore and afloat, and to work which the Fuel Research Board is itself carrying out on the interesting subject of burner design for this purpose, on the principle of so relating the movements of air and the solid particles of fuel that maximum efficiency of contact and rapidity of combustion can be secured. It is to be hoped that the Board will be able to turn its attention to the problem of dust emission from plants using pulverised coal, which promises to become very serious as this method of use is extended in scale.

The largest section of the report is contributed by Dr. C. H. Lander, the Director of Fuel Research. He deals with many subjects, but probably the one to which the most general interest will attach is that of low temperature carbonisation. If one were to choose the branch of work in which the Fuel Research Board has been of the greatest public service, it would surely be either this, or the formulation of the recommendations on which the Gas Regulation Act of 1920 was based. Low temperature carbonisation should, however, take first place, since the Fuel Research Board has not only interested itself in the subject by the examination and testing of quite a number of proposed processes embodying different ideas and types of construction, but also has carried out useful research work and informative experiments by its own staff at the experimental station at Greenwich. The time has now arrived when a limited number of the numerous processes and plants projected for carrying out low temperature carbonisation have reached the stage of full scale technical working and commercial trial. Some of these engage the attention of Dr. Lander in this report, particularly the setting of vertical cast-iron retorts at the Richmond Gas Works, erected by the Gas Light and Coke Company to the general design developed earlier at the Fuel Research Station.

Dr. Lander undertakes a two-page review of the general position of low temperature carbonisation as deduced from the experiments and observations of the Board. It is a summing up, characterised by knowledge, fair-mindedness, and caution, and is neither condemnatory nor eulogistic of any particular process or of the low temperature system as a whole.

So far as the summary can itself be summarised, it points to the necessity for considering every individual undertaking on its merits with due regard on one hand to the nature of the coal it is proposed to treat and the available supply, and on the other to the outlets for the coke, tar, and gas. Of equal importance are the questions of maintenance and depreciation of the plant, which must take a considerable time to ascertain unless the life is short and replacement expenses heavy. Then again come the factors which govern the prices of different classes of coal and the saturation point in the markets for the products. It seems likely that there are situations where low temperature carbonisation of coal can be made to pay, but the incidence of the factors mentioned above has to be considered carefully in choosing a plant and a locality for its installation.

Some experiments are described on the hydrogenation of coal. They are too few in number to allow definite deductions at this stage, but are undoubtedly promising and very interesting from their possible bearing on the constitution of coal. It is reported that by the action of hydrogen under pressure on the Bergius principle, but not carried so far, "a non-caking coal has been converted into solid products with strong caking power, and further experience has shown that carbonaceous materials ranging from cellulose and wood to anthracite, and including all types of coal and lignite, can, by controlled treatment with hydrogen under pressure, be converted into material which on carbonisation, yields a strong coherent coke".

[1] Department of Scientific and Industrial Research. Report of the Fuel Research Board for the year ended 31st March 1929; with Report of the Director of Fuel Research. Pp. viii+127. (London: H.M. Stationery Office, 1929.) 2*s*. net.

In high temperature carbonisation, the principal work of the year has been a study of the effect of size of coal on the working of horizontal and vertical gas retorts, being a continuation on a larger scale of work already carried out at the University of Leeds for the Gas Investigation Committee of the Institution of Gas Engineers. "The general result of the investigation is to confirm that the influence of size of the coal charged is greater with vertical than with horizontal retorts, and that with vertical retorts those variations offer a means of controlling, to some extent, the yields and qualities of the products to suit the needs of particular circumstances. In particular the increased yields of tar may be important."

Among other subjects receiving notice may be mentioned the composition of low temperature tars, combustibility, 'shatter' tests, and reactivity of coke, the effect of oxidation on the coking properties of coal, briquetting, the water gas process, the use of coke for domestic purposes, the heating requirements of a house, an interesting method of expressing fuel consumption in internal combustion engines, and various methods for sampling and analysis. JOHN W. COBB.

The Atlantic Earthquake of Nov. 18, 1929.

AN earthquake that could break a dozen deep-sea cables, that could give rise to destructive sea-waves on the Newfoundland shores, and to a shock felt along 940 miles of the American coast, must clearly have been one of unusual strength.

In Nova Scotia, the shock was felt severely in Halifax, Yarmouth, and other places. In Windsor, chimneys were thrown down. At St. John's (N.F.) the shock was slight, but all along the New England coast, as far as Boston, it was distinctly felt. At the time of the earthquake the White Star liner *Olympic* was about 300 miles from the spot at which cables were broken. The captain reported that, at 3.30 P.M. on Nov. 18, he felt the vessel suddenly quiver, as though she had cast off a propeller blade, and this movement was followed by vibrations lasting for two minutes. The ship was found to be undamaged and there was no wreckage in its wake.

Two and a half hours after the shock was felt, sea-waves flowed up the southern shores of Newfoundland. In Long Harbour, which lies at the head of a narrowing inlet, fishing-booms and stages were damaged by the sea-waves, and 75 yards of roadway were destroyed. A wave, 15 feet in height, swept away several houses in the town of Burin and all the buildings on the water-front. Nine lives were thus lost in Burin and seventeen others at Lord's Cove and Lamalin. In the open ocean the waves must have been much lower, but it might be worth while to examine the mareograms obtained at the western ports of Great Britain for any traces of their passage.

A remarkable effect of the earthquake was the fracture of a large number of telegraph cables. Of the twenty-two cables that traverse the central district, twelve were damaged, and ten of these cross the Atlantic. The probable site of the breakages is said to be in Lat. 44° N., Long. 57° W. The fractures, however, were not concentrated in one spot, for two of the Western Union cables were severed at a depth of 90 fathoms off the coast of Nova Scotia, while a third, belonging to the same company, broke at a depth of 900 fathoms. The exact positions of the fractures will throw light on the origin of the earthquake. It may be that all twelve sites will be found to lie along a straight line, as happened in 1884 with three cables on the south-eastern slope of the Newfoundland Bank. At the same time, it seems quite possible that the earthquake may have had a multiple origin and that a displacement not far from land was responsible for the strong shock felt in Nova Scotia. It is difficult otherwise to account for the damage at Windsor, slight as it was, this town being more than 300 miles from the spot assigned to the fractures. On the other hand, that the sea-waves originated at a distance from land of this order of magnitude seems to be indicated by the long interval that elapsed between the earthquake and the arrival of the waves.

That the disturbed area was one of great size is clear from the length of coast shaken. As Boston is 700 miles from the spot above mentioned, it is possible that the disturbed area may have contained so much as $1\frac{1}{2}$ million square miles, an area that has seldom been exceeded in earthquakes of the last fifty years. C. DAVISON.

Oil-Pools and Fault-Zones.

THE effect of faulting on oil accumulation, equally on oil dispersion, has always been a matter of added interest in working out subsurface conditions, probably because each new case studied presents some peculiar feature worthy of close investigation. So many circumstances enter into the consideration of fault-fields, that were a classification of these alone attempted it would result in a tabular scheme almost, if not quite, as large as those already in existence for other structures, and, moreover, just about as useless. Accumulations dominated by normal fault systems, as at Luling, Texas; by reversed faults, as at Whittier, California; by overthrust faults, as at the well-known McKittrick field, California; by the high factor of porosity in many fault-belt shatter-zones where adequately sealed; by the buffer action of solid bitumen resulting from inspissation of heavy oil along planes of dislocation: these are a few of the many possible expressions of fault-structure capable of influencing storage.

Probably the most difficult cases to elucidate, if not the most important from an economic point of view, are those pools either determined or to some extent controlled by low-angle overthrusting, with its concomitant network of subsidiary 'blatts', or by those thrust-faults in which curvature of the planes, when pronounced, complicates definition except under the most favourable conditions of full well-data. As illustrative of the latter, Mr. Frank Reeves' survey of the Highwood Mountain oil-areas, Montana (*Bulletin* 806-E, 1929, United States Geological Survey), is worthy of note. The type of overthrust most commonly displayed in this region is that in which the surface-trace has a high angle of hade (or low dip) and flattens out in depth by mergence with the stratigraphic planes, so that it becomes, in fact, an almost horizontal thrust at some particular horizon in the area concerned.

Altogether an interesting contribution, although in this region the author concludes that the structures are not favourable to the ultimate location of oil and gas pools.

University and Educational Intelligence.

CAMBRIDGE.—The Vice-Chancellor has appointed Sir James Jeans to be Rede Lecturer for the year 1930.

Dr. R. A. Webb, Peterhouse, has been appointed University lecturer in pathology.

The Raymond Horton-Smith Prize for the year 1928–29 has been awarded to Dr. W. Shaw of St. John's College.

At Pembroke College Mr. J. M. Whittaker has been elected into a fellowship and appointed lecturer and director of mathematical studies. Mr. Whittaker obtained a first class in Part 2 of the Mathematical Tripos in 1927 and was awarded a Smith's prize this year.

LONDON.—Dr. G. A. Harrison has been appointed as from Oct. 1 last to the University readership in chemical pathology tenable at St. Bartholomew's Hospital Medical College. In 1919–24 Dr. Harrison was biochemist to King's College Hospital and lecturer on medical chemistry to the Medical School. For the next two years he was biochemist at the Hospital for Sick Children, Gt. Ormond Street, and since 1926 has been chemical pathologist to St. Bartholomew's Hospital and lecturer on this subject in the Medical College.

The following doctorates have been conferred: D.Sc. in chemistry on Mr. Harry Baines, for a thesis entitled "New Methods for the Analysis of Photographic Products and Raw Materials", and other papers; D.Sc. in physics on Mr. A. C. G. Menzies, for a thesis entitled "The Spectra of Fuses in the Ultra-violet and Schumann Regions", and another paper.

The Right Hon. the Earl Beauchamp was installed as Chancellor of the University on Nov. 22.

H.R.H. PRINCESS MARY has graciously consented to open the new wing of the Battersea Polytechnic on Wednesday, Dec. 11, at 6.15 P.M. The additional accommodation provided will include a physical chemistry laboratory, a bacteriology laboratory, and two lecture rooms.

THE Institution of Chemical Engineers, Abbey House, Westminster, S.W.1, announces that application forms and particulars of its associate membership examination for 1930, together with the memorandum on "The Training of a Chemical Engineer", are obtainable from the Honorary Registrar at the address given. Completed forms must be returned by Dec. 23.

THE Chelsea Polytechnic directs special attention in its prospectus for the current session to its provision for the study of the scientific bases of some modern developments of industrial processes: in the department of physics, for example, technical acoustics and electricity for students of domestic science and demonstrations of electrical domestic appliances; in chemistry, preparation of compounds by industrial methods, technical analysis, including gas analysis, and the chemistry and microscopy of food and drugs; in natural science, the study of plant diseases, genetics, and industrial bacteriology. Its College of Science and Technology embraces mathematics, surveying, physics, chemistry, pharmaceutics, metallurgy, botany, geology, geography, mineralogy, zoology, anatomy, physiology, and hygiene.

Calendar of Patent Records.

December 1, 1671.—On Dec. 1, 1671, Prince Rupert was granted a patent for his new invention of "converting into steel all manner of edged tools, files, etc., forged and formed in soft iron, or any part of the said tools, after they are set, forged, and framed". The patent was to run from May 6, the date of an earlier grant which had been surrendered. In connexion with the patent, Prince Rupert was authorised in the following January to administer an oath to "the several workmen, artificers, and persons concerned in the said arts, neither directly nor indirectly to divulge or make known to any person whatsoever, except his Majesty . . . the said arts or how they are used or with what instruments or materialls the same are made".

December 1, 1898.—The telegraphone, an instrument which utilises the action of magnetism on a magnetisable wire for the recording and reproducing of sounds, was the invention of Valdemar Poulsen, the Danish engineer, who was granted a patent for the invention in Denmark, dated Dec. 1, 1898. The apparatus has the advantage that the recording is not easily interfered with by subsidiary noises, and that the record can be 'wiped out' to enable the same wire to be used again by the simple process of demagnetising the wire. Communications telephoned in the absence of the subscriber at the receiving station are recorded directly by the apparatus and may be given out by it to the subscriber whenever required. The apparatus was also used for the simultaneous transmission of speech to a number of subscribers.

December 2, 1856.—Frederick Siemens' British patent for his regenerative furnace is dated Dec. 2, 1856, and though utilising ideas proposed by Robert Stirling in 1816, is one of the most important in the history of the steel industry. The open-hearth method of making steel by the Martin-Siemens process, rendered possible by this invention, accounts for by far the larger proportion of steel made in the world to-day.

December 2, 1893.—The pince-nez with pivoted nose-grips which can be expanded by the thumb and finger and allow the glasses to be placed easily on the nose with one hand was the invention of the French spectacle maker Jules Collet, and was first patented on Dec. 2, 1893, in Great Britain in the name of A. W. Newbold. The eyeglasses were originally sold under the name of 'Movillette' by Joseph Raphael, opticians, of London.

December 3, 1901.—The United States patent for the Gillette safety razor was applied for on Dec. 3, 1901, and granted in November 1904.

December 4, 1806.—The camera lucida, "an instrument whereby any person may draw in perspective or may copy or reduce any print or drawing", was the invention of William Hyde Wollaston, secretary of the Royal Society, and was patented by him on Dec. 4, 1806.

December 6, 1679.—To John Bellingham is due the introduction of the crown glass industry into England from France. A patent was granted to him and Nicholas Hubin on Dec. 6, 1679, "they having been at great expences in bringing to perfection the manufacture of makeing Normandy window-glass in this kingdom which hath never yet been made here" and manufacture was started probably the same year at Bellingham's glass-house at Vauxhall. A second patent for window-glass was granted to Bellingham in 1685, and by the end of the century crown glass was superior to Normandy glass and fetched a higher price than any foreign window-glass.

Societies and Academies.

LONDON.

Physical Society, Oct. 25.—**E. G. Richardson** and **E. Tyler**: The transverse velocity gradient near the mouths of pipes in which an alternating or continuous flow of air is established. A comparison is made of the alternating and direct flow of air near the mouths of tubes of various sections, by traversal of a hot-wire anemometer across the tube. In the alternating flow, a peak of high average velocity is found near the walls of the pipe, but in one-way flow this annular peak is absent, the velocity falling continuously from the centre of the tube to within a short distance of the walls. The existence of a layer of laminar flow close to the walls, when the main body of air is in turbulent motion, is demonstrated.—**B. K. Johnson**: Resolving-power tests on microscope objectives used with ultra-violet radiation. An object of known regular structure and of variable interval is produced by projecting in the object-plane of the lens under test a reduced image of grating, the apparent line separation of which is varied by rotation of the latter; thus the line interval can be determined when resolution just ceases. The results show that the fused quartz monochromatic object-glass of numerical aperture 0·35, computed for and used with radiation of wave-length 0·275 μ, gives nearly twice the resolving power of a lens of similar aperture computed for and used with light of wave-length 0·51 μ; while the fused quartz monochromatic lens of numerical aperture 1·2 has a resolving power 70 per cent higher than that of a well-corrected object-glass of the same numerical aperture when used with light of wave-length 0·51 μ.

Geological Society, Nov. 6.—**H. Bolton**: Fossil insects of the South Wales Coalfield. A collection of nineteen fossil wings from the South Wales Coal Measures. Several are too fragmentary for determination of genus or species, or both; the remainder are referable to the Palæodictyoptera and Blattoidea. Palæontologically, the insect fauna of South Wales now shows relationships with the insect faunas of the Midland and Northern coalfields, and a close approximation to forms already known from the Coal Measures of Coalbrookdale (Shropshire), the Forest of Dean, and those of Kent, while several of the Hemimylacridian forms are identical with species described by Prof. Pierre Pruvost from the Coal Measures of Pas-de-Calais (Northern France).—**A. R. Dwerryhouse** and **A. Austin Miller**: On the glaciation of Clun Forest, Radnor Forest, and some adjoining districts. The ice, derived originally from the highlands of Central Wales, filled first the depression now occupied by the valleys of the Rivers Ithon and Irfon to the west of the great line of escarpment extending from Kerry Hill on the north, by Radnor Forest and Aberedw Hill, to Mynydd Epynt on the south side of the Wye Gorge. As the ice accumulated, it first found escape by the valleys of the Severn and the Mule on the north, and by the Wye Gorge on the south. Gradually the level of the ice rose, until it overtopped the escarpment throughout its whole length, with, perhaps, the exception of the highest parts of Radnor Forest. The courses of the various glaciers thus formed are traced, and their effects on the drainage of the area are discussed.

Royal Meteorological Society, Nov. 20.—**M. G. Bennett**: The physical conditions controlling visibility through the atmosphere. Visibility of any (large) object is a function of its brightness, and its contrast with the background. When dispersed matter is introduced between the observer and object, the apparent values of these variables are modified, and thus the visibility is altered. The modification is due to: (1) Screening or absorption; (2) glare or superposition of scattered light; (3) diffusion or reduction of definition. It was deduced from this that the obscuring power of a cloud of opaque (carbon) particles was mainly due to screening, whilst that due to water drops was due to diffusion. This should result in a certain difference between the falling off of visibility as an observer recedes from an object in a dry dusty atmosphere, as compared with a humid clean atmosphere. This difference was satisfactorily verified.—**L. F. Richardson**: The reflectivity of woodland, fields, and suburbs between London and St. Albans. A record of measurements made from aeroplanes, using a white-wedge photometer.—**Thora C. Marwick**: The electric charge on rain. Thunderstorm rain showed a high positive charge per cubic centimetre. Of the total quantity observed, 94·6 per cent was positively charged. Non-thunderstorm rain showed a lower charge per cubic centimetre and a lower percentage of positively charged rain, 79·5 per cent. Hail and rain mixed showed a large excess of negatively charged drops, only 39·4 per cent of the total quantity being positive. The charge per cubic centimetre was approximately the same as for non-thunderstorm rain.

PARIS.

Academy of Sciences, Oct. 21.—**E. Fournier**: The magnetic guidance of ships. Description of some improvements in apparatus for guiding ships electrically into a port, due to W. Loth.—**A. Cotton**: The action of polarised light on certain photographic plates prepared with solutions of colloidal silver. Experimental studies on the Weigert phenomenon. Possible explanations are discussed: the hypothesis of a photoelectric effect is examined and rejected.—**E. L. Bouvier**: The classification and geographical distribution of the hemileucidian Saturnioidæ, sub-family Automeris.—**E. Mathias**: Contribution to the study of fulminating matter. The lowering of the surface tension by impurities.—**Charles Dhéré**: An arrangement permitting the compensation of the variations of the luminous intensity resulting, in the spectrum, from the mode of dispersion by the prisms.—**Eugène Slutsky**: The mean quadratic error of the coefficient of correlation in the case of series of non-independent proofs.—**E. Bompiani**: The tetrahedra invariant by projective applicability attached to the points of a surface.—**Chevalley**: The theory of ideals in infinite algebraic bodies.—**Jacques Chokhate**: The integrals of Stieltjes.—**Krawtchouk**: A generalisation of the polynomials of Hermite.—**Georges Valiron**: Meromorph algebroid functions of the second degree.—**Henri Cartan**: The differential with respect to log r of the growth function $T(r; f)$.—**Podtiaguine**: The regularity of functions with very rapid and very slow growth.—**D. Riabouchinsky**: The determination of a surface from the data that it bears.—**A. Lapresle**: A new principle for setting up large aerodynamical wind chambers.—**D. Rosenthal**: Verification of the resistance of soldered joints by an extensometric method without destruction of the coupling.—**Pauthenier** and **Mallard**: Contribution to the study of the cylindrical field in ionised air at the ordinary pressure.—**A. Kling** and **A. Lassieur**: The hydrogen exponent of water. In earlier work the authors have found a value of 5·8 for the pH of pure water: this is now confirmed by an entirely different method.—**Auguste Le Thomas**: The influence of the structure of the casting on the alterations undergone at high temperatures. The structure of cast iron has a distinct effect on the formation of graphite.—**P. Job** and **Liou Oui Tao**: The cobaltiaquopentammonic and diaquo-

tetrammonic sulphates.—**Ch. Bedel**: The catalysis of the solution of silicon in hydrofluoric acid and the influence of tempering. The presence of certain substances which may be present as impurities in silicon increase the solubility of this element in hydrofluoric acid. On the other hand, this solubility is unaffected by the change into the β and γ varieties of silicon described by Koenigsberger and Schilling.—**L. Bert and M. Anglade**: A new method of synthesis of propylbenzene, of propenylbenzene and of their homologues. The synthetic method is general and is based on an unusual reaction, that of sodium and alcohol on compounds of the type $R \cdot CH = CH - CH_2 - O - R'$, in which R is an aryl group. Instead of the reduction product expected, a mixture of the hydrocarbons $R \cdot CH_2 \cdot CH_2 \cdot CH_3$ and $R \cdot CH = CH - CH_3$ is obtained in good yield. Details are given of two examples.—**Maurice Fontaine**: The action of high pressures on the respiration of the algæ. The consumption of oxygen by the alga diminishes as the pressure is raised, a result exactly opposite to that obtained with animals.—**Aug. Chevalier**: The invasion of the mouths of the Rivers Adour and Bidassoa by *Spartina glabra*.—**Raymond-Hamet**: Sparteine and hordenine.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—**G. Armellini**: Measurements of double stars. The results are given of measurements of 56 double stars made with the Cavignato equatorial of the Royal Campidoglio Observatory (aperture 7 inches, focal length 2·383 metres, magnification about 600 diameters).—**G. Abetti**: Altitude of the chromosphere in 1928 and course of the present solar cycle. Measurements made at Arcetri indicate a general lowering of the chromosphere from 10·3″ in 1927 to 10·2″ in 1928, whereas those made at Madrid give the same value, 10·1″, in each of these years. Favaro and Taffara's observations at Catania show a more marked lowering, namely, from 8·5″ to 7·8″. The altitude is almost constant at all latitudes and it appears that the maximum was reached in 1926, this coinciding with the maximum activity of the protuberances. The total area of the latter, measured in units of protuberance, fell by 298 from 1926 to 1927 and by 53 from 1927 to 1928. Moreover, in 1928, the secondary maximum of the areas of high latitude had quite disappeared, the other maxima being distributed irregularly in both hemispheres. Curves expressing the height of the chromosphere, the area of the protuberances, and the relative number of spots from 1921 to 1928 indicate general concordance between the three magnitudes, except that the number of spots has continued to increase up to 1928.—**Maria Pastori**: The partial derivation of tensors.—**M. Picone**: Particular formula for the solutions of a classical fourth order equation of mathematical physics with partial derivatives.—**R. Caccioppoli**: Indefinite integration.—**A. M. Bedarida**: The theory of ideals of a finite algebraic body.—**B. Segre**: Existence and dimensions of continuous systems of plane algebraic curves with given characters.—**M. Lelli**: A new experimental result on the contraction of liquid veins. An experimental arrangement is described by means of which it is possible, as was anticipated by Levi-Cività's theory, to obtain an efflux of water with a coefficient of contraction less than one-half.—**E. Gugino**: The intrinsic equations of the motion of material systems with linkages independent of the time.—**O. Belluzzi**: The behaviour of elastic segmental arches.—**A. Belluigi**: Fundamental physical characteristics of the Paduan plain.—**P. Dore**: The influence of the elasticity of the support on the duration of oscillation of two pendulums oscillating on it.—**M. Tenani**: Theoretical-experimental considerations on the course of the tides of the Adriatic Sea.—**E. Fermi**: The quantistic theory of interference fringes. On the basis of Dirac's theory of radiation, a theory is evolved of Lippmann's fringes. The method adopted is applicable generally to the treatment of any interference phenomenon, and the result arrived at coincides with that of the classical electromagnetic theory.—**W. Del Regno**: The total emissive power of bismuth.—**R. Fedele**: A comparison between the variations with the magnetic field of the Hall coefficient, the thermo-electric power, and the resistance in ordinary and compressed bismuth. Experiments with bismuth indicate that, even if the magnetic field causes structural modifications in the metal, these have no influence on the variation of the Hall effect, the thermo-electric power, and the resistance. It must, therefore, be concluded that such variations are due exclusively to purely electrodynamic actions, and that the failure of the electronic theories to explain these phenomena is to be numbered among the negative proofs of the theories.—**S. Oberto**: A supposed effect of X-rays in crystal rectifiers. The results of experiments with the Cuprox rectifier, commonly used for charging small accumulators, indicate that sparks establish a more intimate contact between the external electrode and the cuprous oxide of this rectifier, and between the point and the crystal in galena rectifiers. Hence, Jackson's experiments on the effects of ultra-violet and X-rays on the characteristics of crystal rectifiers do not fully prove, in so far as X-rays are concerned, the supposed effect of these rays.—**E. Perucca**: The sensitiveness of electrometers. A conceptual difference in behaviour between quadrant, leaf, and wire electrometers used for the measurement of very small differences of potential by the heterostatic method is pointed out.—**V. Caglioti and L. Malossi**: Double sulphates of bismuth and alkali metals (2). Double sulphates of bismuth and ammonium. Addition to concentrated bismuth nitrate solution acidified with nitric acid, of ammonium sulphate in amounts required for the 1 : 1- and 1 : 3-compound gives at 25° the latter, namely, $(NH_4)_3Bi(SO_4)_3$, in both cases. This double salt is in equilibrium with solutions containing between 25·5 and 40·36 per cent of ammonium sulphate. The compound $NH_4Bi(SO_4)_2$ may be obtained in the anhydrous form by crystallisation from solutions of bismuth nitrate and ammonium sulphate, although Lüddecke prepared it in the octahydrated state.—**G. Charrier**: Polycondensed heteronuclear systems. When applied to 2-N-phenyl-1 : 2-naphtho-1 : 2 : 3-triazolequinone, Bally's synthesis of benzanthrone from anthraquinone, which was extended to phenanthraquinone by Turski and Prabierowa, yields a compound which appears to be the 2-N-phenyltriazole analogue of benzanthrone.—**A. Bianchi**: Petrographical observations in the region of the Aurine Alps and Giant Vedrettes.—**S. Ranzi**: Experimental embryological investigations on the cyclostomes: (1) the malformations observed and the time in which they may be determined. Experiments on the ova of *Petromyzon planeri Bl.* show that, in non-fatal doses, lithium chloride never results in irreversible modification of an organ which is developing at the moment the salt acts, but may only determine modifications of processes which begin some time after the action of the salt commences.—**G. Reverberi**: Results of experiments on the development of the eye in hen's embryos.—**C. Guareschi**: Otocysts of *Anura* considered as a mosaic system. Experimental demonstration.—**R. Margaria**: The reaction-regulating power of sea-water. In view of the interest attaching to sea-water as a physiological liquid, its titration curves with dilute solutions of

alkali and strong acid have been studied. In the acid zone and in the first part of the alkaline zone, sea-water exerts but little resistance to displacement of its reaction, but from *p*H 10-11 onwards, a relatively high addition of sodium hydroxide produces but little change in the hydrogen ion concentration. The latter effect is, however, not a true buffering, but is due to the precipitation of magnesium hydroxide. At *p*H 7·4, the buffering power of sea-water is only 0·0016, whereas that of blood serum is 0·0206.—A. Galamini: Partial inanition of albino rats with olive oil, administered with or without added vitamins.—G. Finzi: Anæsotuberculin in the diagnosis of tuberculosis in comparative pathology.

Official Publications Received.

BRITISH.

Royal Society of Arts. Cantor Lectures on The Treatment of Coal, delivered before the Royal Society of Arts on Jan. 21st, 28th, and Feb. 4th, 1929, by Dr. C. H. Lander. Pp. 49. (London.) 2*s.* 6*d.*

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1249 (Ae. 400): Measurement of Lateral Derivatives on the Whirling Arm. By L. W. Bryant and Dr. A. S. Halliday. (T. 2757.) Pp. 6+10 plates. 6*d.* net. No. 1253 (M. 64): Report on some Properties of Alloys of Aluminium with Thorium and Silicon. By J. G. Grogan and T. H. Schofield. (A. 63.) Pp. 12+11 plates. 1*s.* 6*d.* net. No. 1257 (Ae. 406): Comparison of Calculated and Measured Elasticity of the Wings of an Aircraft, in connection with the Investigation of Wing Flutter. By K. T. Spencer and D. Seed. (Ft. 41.) Pp. 9+2 plates. 9*d.* net. No. 1261 (Ae. 410): Experiments on the Spinning of a Bristol Fighter Aeroplane. By K. V. Wright. (T. 2793.) Pp. 7+2 plates. 6*d.* net. No. 1244 (M. 63): The Influence of Oxygen on Corrosion Fatigue. By A. M. Binnie. (E.F. 213A.) Pp. 3+5 plates. 6*d.* net. No. 1258 (Ae. 407): Notes on the Flutter of Airscrew Blades. By E. Lynam. (Ft. 49.) Pp. 5+6 plates. 6*d.* net. No. 1263 (Ae. 412): Full Scale Determination of the Motion of an Avro Aeroplane when Stalled. By K. W. Clark and W. G. Jennings. (T. 2790.) Pp. 6+5 plates. 9*d.* net. No. 1262 (Ae. 411): The Application of the Servo Principle to Aileron Operation. By A. S. Hartshorn. (T. 2792.) Pp. 16+5 plates. 9*l.* net. (London: H.M. Stationery Office.)

Ordnance Survey. Results of the Magnetic Observations made by the Ordnance Survey in England in 1927, and Preliminary Results (Declination only) of those made in England and Wales in 1928. Pp. 7. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

County Council of the West Riding of Yorkshire. Twenty-fifth Annual Report of the Education Committee, 1928-29. Pp. 99. Handbook of the Education Committee. Part 2: Higher Education. Section 9: Regulations relating to Training of Teachers, 1930. Pp. ii+14. Section 10: Regulations relating to Scholarships and Exhibitions, 1930. Pp. iii+54. (Wakefield.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 16: On Abnormal Teeth in certain Mammals, especially in the Rabbit. By Prof. W. C. M'Intosh. Pp. 333-407. 9*s.* 6*d.* Vol. 56, Part 2, No. 17: The Metamorphic Rocks of Kintyre. By William J. McCallien. Pp. 409-436. 3*s.* 6*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 13: Land-Grant Colleges and Universities, Year ended June 30, 1928. By Walter J. Greenleaf. Pp. v+81. 15 cents. Bulletin, 1929, No. 25: Trends in Home-Economics Education, 1926–1928. By Emeline S. Whitcomb. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 76, Art. 5: Three New Land Shells of the Genus Oreohelix from Arizona. By William B. Marshall. (No. 2802.) Pp. 3+1 plate. (Washington, D.C.: Government Printing Office.)

Bernice P. Bishop Museum. Bulletin 65: Report of the Director for 1928. By Herbert E. Gregory. Pp. 58+3 plates. (Honolulu.)

Japanese Journal of Botany. Transactions and Abstracts. Vol. 4, No. 4. Pp. v+317-426+81-110. (Tokyo: National Research Council of Japan.)

Division of Fish and Game of California. Fish Bulletin No. 17: Sacramento–San Joaquin Salmon (*Oncorhynchus tschawytscha*) Fishery of California. By G. H. Clark. Pp. 73. (Terminal, Calif.: California State Fisheries Laboratory.)

The Rockefeller Foundation. Annual Report, 1928. Pp. xi+460. (New York City.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 7, Part 2, September. Pp. 193-388+plates 10-30. (Tokyo.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 12, No. 5, September. Pp. 227-274. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.30 yen.

The Science Reports of the Tohoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 4, No. 3. Pp. 473-576+plates 19-25. (Tokyo and Sendai: Maruzen Co., Ltd.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 3, Septembre. Pp. 101-147. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Bulletin of the National Research Council. No. 72: Fellowships and Scholarships for Advanced Work in Science and Technology. Compiled by Callie Hull and Clarence J. West. Second edition. Pp. 154. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

CATALOGUES.

The Cambridge Bulletin. No. 64, November. Pp. 24+8 plates. (Cambridge: At the University Press.)

Medicinal Glucose (Pure Dextrose) B.D.H. Pp. 7. (London: The British Drug Houses, Ltd.)

A Christmas Catalogue of Book Bargains. (No. 336.) Pp. 32. (Cambridge: W. Heffer and Sons, Ltd.)

"Carola" Photo-Electric Cells and Vacuum Relays. (List C. 1029.) Pp. 8. (London: Isenthal and Co., Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 29.

INSTITUTE OF CHEMISTRY (Belfast and District Section) (at Queen's University, Belfast), at 5.—R. L. Collett: The Professional Aspects of a Career in Chemistry.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. H. Parsons and others: Debate on The Registration of Reliable Tests of Power Plant Machinery.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. C. Freeman: Modern Welding Systems and Applications.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—Dr. J. N. Friend: Science in Antiquity.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates Section) (at 51 West Regent Street, Glasgow), at 8.—J. W. Robertson: Two-stroke Engines: Some Experiments on a New Type.

SATURDAY, NOVEMBER 30.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (Newcastle-upon-Tyne), at 3.—F. Y. Pattern: A Few Notes on Miners' Nystagmus.—Paper open for further discussion:—Machine Mining in Faulted Ground, by A. L. Ford.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL IRISH ACADEMY (Dublin).

MONDAY, DECEMBER 2.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Sir Ambrose Fleming: The Garden Tomb at Jerusalem: A Possible Site of the Resurrection.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. V. G. Childe: The Early Colonisation of Northern Scotland as illustrated by the Recent Discoveries in Orkney.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—C. S. Chettoe: Some Points in Reinforced Concrete Bridge Design.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (Annual General Meeting) (at London Day Training College), at 6.—Miss Lucy Fildes: Child Guidance Clinics.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—Dr. B. P. Haigh: The Relative Safety of Mild and High Tensile Steel under Alternating and Pulsating Stresses.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Branch) (at Loughborough College), at 7.—H. G. Nicoll: Carburettors and Carburation.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—R. A. Chattock: The Modern Use of Pulverised Fuel in Power Stations.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. G. Richardson: Wind Instruments from Musical and Scientific Aspects (Cantor Lectures) (III.).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—O. M. Tweedy: The Central African Highway.

TUESDAY, DECEMBER 3.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (Annual General Meeting) (at Winchester House, E.C.), at 6.30.—W. E. Glegg: The Birds of Middlesex since 1866 (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (Informal Meeting) (at North British Station Hotel, Edinburgh), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—F. Judge: The Possibilities of Night Photography.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Branch) (at Broadgate Café, Coventry), at 7.15.—P. Wheeler: Commercial Vehicle Engines.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—M. A. Phillips: British Wild Life.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—J. B. Hoblyn: Aluminium Alloys from the User's Point of View.

TELEVISION SOCIETY (at Engineers' Club), at 8.—E. G. Lewin: Television: Some Suggested Schemes.

ROYAL EMPIRE SOCIETY, at 8.30.—Sir Richard Gregory: Science and the Empire.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—A. L. Armstrong: Report of Excavations in the Cave of Bambata and at the Victoria Falls, South Rhodesia, 1929.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—W. H. Ogilvie, H. Platt, J. Verrall, and others: Discussion on Minor Injuries about the Elbow Joint.

WEDNESDAY, DECEMBER 4.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. E. Greenly: Foliation in its Relation to Folding in the Mona Complex at Rhoscolyn (Anglesey).—H. P. Lewis: The Avonian Succession in the South of the Isle of Man.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—G. Shearing and Capt. J. W. S. Dorling: Naval Wireless Telegraphy Communications.
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—G. Crift: Coke Carbonisation and Bye-Products.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 29 Hart Street, W.C.1), at 7.—R. C. Ching: Costing Methods for Heating Engineers.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—R. Munton: Pulverised Fuel: Past and Future.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Metropole Hotel, Leeds), at 7.30.—A. Healey: The Pneumatic Tire in Heavy Transport.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Prof. A. P. Laurie: The Methods of Examining Pictures (Lecture).—R. L. Andrew: The Determination of Minute Amounts of Iodine in Soils and Waters.—Dr. S. Glasstone and J. C. Speakman: The Quantitative Analysis of Mixtures of Nickel and Cobalt.
ROYAL SOCIETY OF ARTS, at 8.—H. H. Peach: The Advertiser and the Disfigurement of Town and Countryside: Criticisms and Suggestions.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Pathological Evening.
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Derby Technical College).—Lt.-Col. H. E. O'Brien: Electric Traction.
ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.—F. L. Arnot: Electron Scattering in Mercury Vapour.—F. A. B. Ward, C. E. Wynn-Williams, and H. M. Cave: The Rate of Emission of Alpha Particles from Radium.—Dr. E. J. Williams and F. R. Terroux: Investigation of the Passage of Fast Beta Particles through Gases.—*To be read in title only*:—E. P. Perman and W. D. Urry: The Compressibility of Aqueous Solutions.—R. J. C. Howland: On the Stresses in the Neighbourhood of a Circular Hole in a Strip under Tension.—G. S. Adair: The Thermodynamic Analysis of the Observed Osmotic Pressures of Protein Salts in Solutions of Finite Concentration.—E. B. R. Prideaux and F. O. Howitt: The Electrophoresis of Protein Sols in the Presence of Gold Sols—Albumen Gelatin and Casein.—S. Bhagavantam: The Magnetic and Optical Properties of the Benzene Ring in Aromatic Compounds.—E. C. Watson and J. A. Van den Akker: Differences in the Directions of Ejection of X-Ray Photo-Electrons from Various Atomic Levels.—Prof. C. R. Goldsbrough and D. C. Colborne: The Tides in Oceans on a Rotating Globe. III.—A. M. Mosharrafa: Wave Mechanics and the Dual Aspect of Matter and Radiation.—Dr. H. T. Flint: On the Determination of the Range of Frequencies within the Group of Mechanical Waves of an Electron.—Dr. H. Spencer-Jones: The Light of the Night Sky: Analysis of Intensity Variations Observed at the Cape, at Canberra, and in England.
LINNEAN SOCIETY OF LONDON, at 5.—Mrs. E. S. Grubb: The Biological Station of Alto da Serra, Sao Paulo, Brazil.—Continuation of the Discussion of the Proposed Introduction of Black Buck into Ceylon.
PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir Israel Gollancz: Problems in the Alliterative Poems.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Saleeby: Sunlight and the Child.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. H. Norinder: Surges and Over-Voltage Phenomena on Transmission Lines due to Lightning and Switching Disturbances.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30—J. de la Cierva: Recent Work on the Autogiro.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—H. M. Stanley: Petroleum and Petroleum Gases in Chemical Raw Materials.
CHEMICAL SOCIETY, at 8.—U. R. Evans and J. Stockdale: Passivity of Metals. Part III. The Quantity and Distribution of the Superficial Oxide.—H. Baines: The Argentothiosulphuric Acids and their Derivatives. Part I. The Preparation of the Sodium Salts and the Isolation of Monoargentomonothiosulphuric Acid.—Prof. W. N. Haworth and C. R. Porter: (*a*) Sugar Carbonates. Part IV. The Dicarbonates of Glucose, Fructose, Mannose, Galactose, and Arabinose; (*b*) Isolation of Crystalline α- and β-ethylglucofuranosides (γ-ethylglucosides) and other Crystalline Derivatives of Glucofuranose.
C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Debate on Birth Control. M. I. Finucane, opposing; Dr. Marie Stopes, defending.

FRIDAY, DECEMBER 6.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—J. P. Davidson: The Manufacture of Tobacco.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 6.—Prof. Dempster Smith: Cutting Capabilities of Lathe Tools.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of Rubber Industry) (at Engineers' Club, Manchester), at 7.—H. C. Young: The Common Factors of Technical and Works Controls in the Rubber and Chemical Industries.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Dr. C. V. Drysdale: Alternating-Current Potentiometers and their Applications.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. A. Tookey and others: Diesel Engine Developments.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Bairstow and others: Discussion on How can the Pictorial Group best help the would-be Pictorialist?
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—A. B. Gowring: The Demolition of Lambeth Bridge.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—The Great Barrier Reefs and the Queensland Coast: a Geographical Reconnaissance (Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Hugh Walpole: The Novel and the Creative Spirit.

SATURDAY, DECEMBER 7.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Exeter), at 3.—Lieut.-Col. E. J. Stead: The Local Government Act, 1929.
GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—W. H. Spreadbury: Some Birds of London's Country.
MINING INSTITUTE OF SCOTLAND (at Glasgow).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 29.

COLLEGE OF MEDICINE (Newcastle-upon-Tyne), at 8.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 30.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Hydra in Fact and Fiction.

MONDAY, DECEMBER 2.

ROYAL COLLEGE OF SURGEONS, at 4.—F. W. Twort: The Relation of Pathogenic to Saprophytic Micro-organisms. (Succeeding Lectures on Dec. 4, 6, 9, and 11.)
LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers (3): The Exploration of Eastern Waters to China. Unknown Southern Continents.

TUESDAY, DECEMBER 3.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. A. W. Ashby: Changes in Prices of Farm Produce and their Causes.
UNIVERSITY OF LEEDS, at 8.—Prof. J. W. McLeod: Immunity.
INNER TEMPLE HALL, at 8.15.—Dr. W. A. Robson: Public Health Law and Administration introduced by the Local Government Act, 1929 (Chadwick Lecture).

WEDNESDAY, DECEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. C. Jordan: Dress in Relation to Health and Disease.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. H. P. Mosher: The Lower End of the Esophagus at Birth and in the Adult (Semon Lecture).

SATURDAY, DECEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—Prof. H. Levy: Dimensional Theory as a School Subject (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: British Wild Life off the Beaten Tracks.

EXHIBITION, ETC.

DECEMBER 4, 5, AND 6.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (at Central Hall, Westminster).

Wednesday, Dec. 4, at 2.30.—Official opening of Exhibition by The Rt. Hon. Arthur Greenwood.

At 3.15.—Prof. Gösta Forssell: Radiotherapy of Malignant Tumours in Sweden (Mackenzie Davidson Memorial Lecture).

At 8.45 (at 32 Welbeck Street).—Dr. G. B. Batten and others: Discussion on The Requirements of Clinicians from Radiologists and *vice versa*.

Thursday, Dec. 5, 10.30 A.M. to 12.30 P.M.—Discussion on Aspects of Radiation Therapy.

At 2.30.—Prof. F. L. Hopwood and Miss F. E. Smallman: The Use and Abuse of Radium Needles.

At 6.—Prof. A. S. Eddington: X-rays in the Stars (Silvanus Thompson Memorial Lecture).

Friday, Dec. 6, 10.30 A.M. to 12.30 P.M.—W. E. Schall: A Single Valve Plant for Diagnosis and Deep Therapy.—Cuthbert Andrews: A Mobile X-ray Unit.—Dr. Ffrangcon Roberts: Modern Radiological Developments in Germany with Special Reference to the New Institute at Frankfurt.—Dr. A. Orliansky: Output of Transformers under Different Methods of High Tension Rectification.—W. R. Gray: A Hot Cathode Tube with Rotating Anode.—Dr. E. J. H. Roth: The Mekapion, an Ionisation Apparatus for the Absolute Measurement of X-ray Dose.

At 2.30.—Miss S. F. Cox and F. G. Spear: Tissue Culture and its Application to Radiological Problems.—Miss S. F. Cox: The Action of X-rays on Living Cells Cultivated *in vitro*.—Dr. F. G. Spear: The Immediate and Delayed Effects of Radium on Tissues Cultivated *in vitro*.

CONFERENCE.

DECEMBER 5 AND 6.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—Vapour Absorption and Adsorption.

Thursday, Dec. 5, at 10.30 A.M.—Prof. J. C. Philip: The Reversibility of the Adsorption Process and the Thickness of the Adsorption Layer.—Dr. W. R. Ormandy: The Recovery of Acetone Vapours from the Air.

At 2.30.—H. Hollings, Dr. S. Pexton, and Dr. R. Chaplin: The Recovery of Benzol from Coal Gas, with Special Reference to the Use of Activated Carbon.—H. W. Webb: The Absorption of Nitrous Gases.

Friday, Dec. 6, at 10.30 A.M.—A. Hoch: The Recovery of Volatile Solvents (Brégeat Process).—J. S. Morgan: The Continuous Fractionation of Gases by Adsorbents.

At 2.30.—G. W. Himus: Evaporation of Water in Open Pans.—E. Evans and H. F. Pearson: The Industrial Application of Active Carbon

Public L... LAWRENCE

NATURE.

SATURDAY, DECEMBER 7, 1929.

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The Nation and Research.[1]

THERE is no need to dot the i's and cross the t's of the remarkable pronouncement on scientific research delivered by Sir Walter Fletcher and quoted extensively in Nature of Nov. 23. It may be said to have contained nothing new : it may, with equal justice, be said that its whole burden and content was new. In it, a great public official who is also a man of science illuminated every facet of a problem which intimately concerns the future of human life. The revealing beam was not uniformly intense, and wisely so. Aspects exist of which it may be said that a pale and gentle light upon them suffices for the time being.

Candle-power will be needed later, and then there will come into play the same dispassionate scrutiny as science accords to all those appearances which more partial judgments stigmatise ill-proportioned. The time will come. What is new in the masterly treatment which the Norman Lockyer lecturer gave to an urgent topic is the promise it affords that the time will come swiftly. It is not that the intellectual resources of England, nay, of the world, should be reorganised. It is that they are even now being recast by minds of whose effective potency the world has been abundantly assured. What Sir Walter Fletcher demands, and the best scientific opinion is with him, is something perfectly clear and consistent. What he calls the " national habit of thought about science " is not, of course, strictly national. It is a world habit which that taste for mixing the true with the untrue, the wise with the unwise, the noble with the ignoble, the effectual with the ineffectual ; that taste for mixing and muddling (which Englishmen prize themselves for priding themselves upon) only accentuates in us. He has attacked this habit trenchantly. With what we must believe to be considerable courage, he has dared even to define the dangers to which the very fruitfulness of science exposes it.

" The State ", said Burke, " is a partnership in all science, a partnership in all art, a partnership in every virtue and in all perfection " ; and so too Sir Walter Fletcher, " that Government will always be wise that makes the Universities strong and leaves them free ".

Here lies the crux of the problem of intellectual reconstruction in England. Here all plans must have their origin, all aims their inspiration, and all discussion its starting-point and its end. Is it

[1] Medical Research : the Tree and the Fruit. By Sir Walter Morley Fletcher. (The Norman Lockyer Lecture, 1929.) Pp. 27. (London : The British Science Guild, 1929.) 1*s*.

possible to frame such a constitution for the universities of Great Britain, and after Great Britain the world, as will make them strong with the strength not only of great States, but also with the strength of the irresistible power of the human mind, sceptreless, free, uncircumscribed?

The question is born of the times, set before us as an aim of practical politics by one who is at the heart of the problem, secretary to one of those committees of the Privy Council in closest touch with each side of the triangle: the "bitter need of suffering men and women", the "national habit", and the devices of a profession. Of these three, the needs of men are constant; the "national habit", also, is all too constant; only for one profession we may write another and again another until the whole field of science will be comprised. The problem is defined, and with equal clearness, the essentials of reform. Equity demands that "if usefulness is to be measured by prominence and influence in the State" it shall be served accordingly; and usefulness rests upon a condition: that science "be left free to follow the clues to new knowledge as Nature lays them down and not as administrative officers may appoint". The administrative officer has, of course, disguises which it is unnecessary to pierce for the moment.

Here are plain indications of the essentials of future policy, resolving into administration and finance of the universities. No university is, of course, wholly scientific. But if science should be the means of elevating the condition of the rest, the result may be no worse than a displacement of the baser legends of scholarly gentility. Where there is great science, there also is high culture. Every claim to national respect for science is a claim equally for all sincere and disinterested thought.

The expenditure of the universities of England is less than four millions a year. (The cost of the lunatics of England has been eight.) To assess the value of the universities would be impossible. They are creators of values. To allocate to them what they need and can use would be to subtract from the present and the yearly wealth of the country a minute and unnoticable portion. In the old days such a portion was subtracted from the value of crops and given to the Church. The Church was left free under a Board of Commissioners and a Bench of Bishops to manage its affairs, to study and to teach, to accept the gifts of the laity in stones and carving, in money and in kind. At the worst she could sell prayers. Most of the fruits of science, all the richest of them, enrich the world without being in themselves saleable commodities. All that is best in a new fact, a new idea, or a new ideal synthesis, all that is best in science is from the moment of its birth the property of all; and despite the fact that in science doctrine does not exist to confuse and disintegrate, it is the Church and not science that is to-day the superior in status, in emoluments, and in freedom from the dictation of the vain and the ignorant.

Here are, we believe, the materials for reconstruction ready at hand, with every indication that historical experience can afford for correction and improvement. A State department, no. In "The Apple Cart" of Mr. Bernard Shaw, it is King Magnus, not a Minister, who speaks of protecting science from prostitution to the professions. Science is the concern of the State; it must not be the tool of the State even if in that guise its lot would be better than now when it is the hobby of philanthropy and the tool of commerce.

The present position is as absurd as it is intolerable. Private generosity provides scarcely more than a tenth of the income of the universities. Yet it retains effective control. It is for this reason that the "national habit" is even more firmly entrenched within the universities than in the Press and the street; the promises of charters and statutes, insufficient as these are, out of measure imposing in comparison with the meagre performances of the laboratories. Teaching, at the university level, is impossible without research, and probably, though less certainly, research is improved by contact with common needs. But it is not essential that changes immediately apparent in the form or even the personnel of governing bodies are necessary. Small changes of the right kind may go far: it is the sources and the character of the inspiration of policy that stand in need of change. Finance and stability are the clear lines for improvement. For the correction of the "national habit" itself, a people trained in a single science, not alone in the facts and uses of that science, but also in its discipline and method, will at least have received the means of entering fully into the spirit of all science.

We foresee strenuous opposition to the course on which Sir Walter Fletcher has set us, and at the same time we find it hard to envisage a vast army of support. But there is weight of support. The universities, except the greatest of them, are frightened and demoralised, the cross currents of interest baffling. But we reassert our conviction that the address is the beginning of a new era in the life of the country. It sets an urgent practical problem for solution.

Enzymes.

Untersuchungen über Enzyme. Von Richard Willstätter. Band 1. Pp. xvi + 860. Band 2. Pp. xi + 861-1775. (Berlin: Julius Springer, 1928.) 124 gold marks.

IN these two volumes, which are dedicated to Dr. Fritz Haber, there are reprinted the collective memoirs on the subject of enzymes from the school of one of Germany's greatest chemists. The collection comprises more than a hundred and thirty original contributions to the subject, the first eight of which are summaries of our knowledge. The vast number of co-workers whose names are given suggests team work, but if this be so, the greatest homage must be paid to the master mind that directed it.

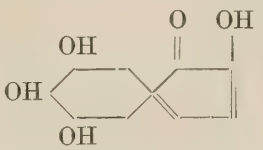
Prof. Willstätter and his school have attacked a chemico-biological problem from the point of view of the pure chemist. Prof. Willstätter may, in fact, be compared with the late Prof. Emil Fischer. His researches, like those of Fischer, have been directed towards unravelling the constitution and structure of naturally occurring substances, and his achievements have not been in vain, for they have shown the physiologist and the biochemist the nature of a series of basal units of substances met with in Nature, and have thus laid the foundation on which attempts may be made to elucidate their physiological function and metabolism in the more complex colloidal state in which they occur in the animal and plant.

It is quite unnecessary to summarise at any length the advancement of our knowledge due to Willstätter's researches: this is well known and was described by Prof. H. E. Armstrong when Willstätter was added to NATURE'S series of "Scientific Worthies" in the issue of July 2, 1927. But in leading up to a short review of his work on enzymes, it will be useful to give a brief historical outline of his earlier work in the sequence in which he has drawn it up in the introductory chapter of this series of papers. The work on chlorophyll having been brought to a provisional conclusion, Willstätter commenced the study of hæmoglobin; in this the remarkable discovery was made that it is possible to obtain from both chlorophyll and hæmoglobin a common derivative, ætioporphyrin. Studies on the colouring matters of petals were then commenced, and these were shown to be the oxonium salts of three closely related substances, pelargonidin, cyanidin, and delphinidin. These studies were, however, brought to a close by the outbreak of the War.

Willstätter's work on enzymes really commenced with the discovery in 1910 of chlorophyllase, an enzyme present in all green leaves. Experiments *in vitro* showed that in alcoholic solution it hydrolyses colloidal chlorophylls into ethyl chlorophyllides and the complicated α-β unsaturated primary alcohol, phytol. The majority of the work on enzymes, however, has been published since the close of the War.

The two volumes are divided into ten sections, the first of which comprises eight papers of the nature of summaries. In this first section the opening paper is the Faraday lecture delivered before the Chemical Society in London in 1927. The other sections are concerned with original researches on the following subjects: Analytical work, adsorption, chlorophyllase, peroxsidase and catalase, sucrase, maltase, lactase, the specificity of enzymes, the lipases and the proteases.

Although, as already stated, Willstätter's work on enzymes commenced in 1910 with the discovery of chlorophyllase, his general study of the subject dates from 1918. Before the various problems could be attacked it was necessary to devise special analytical methods, and a series of papers was published dealing with these. He greatly increased the accuracy of the iodometric method of estimating glucose as well as that of the colorimetric estimation of iron by means of ammonium thiocyanate. Alkalimetric methods of estimating amino acids and peptides, as well as of magnesium and calcium, were also revised. The want was felt of an accurate micro-method of estimating phosphoric acid, and gravimetric and volumetric methods were devised for this purpose in Willstätter's laboratory by R. Kuhn. It was shown that the production of purpurogallin by the action of plant peroxidases and hydrogen peroxide on pyrogallol might be used for the estimation of the enzyme. Incidentally, Willstätter proved that the constitution of purpurogallin is



whilst he accepts A. G. Perkin's view that the constitution of the isomeric purpurogallon is 6 : 7 : 8 trihydroxy α naphthoic acid.

Truly remarkable is Willstätter's work on the different hydrogels of alumina, stannic acids, and silica, and the use to which he put these as adsorbents in the purification of enzyme preparations. According to Michaelis, enzymes exhibit the

phenomenon of kataphoresis and are therefore to be regarded as electrolytes, in most cases amphoteric. Enzymes that are adsorbed by electro-negative kaolin were regarded as more basic, whilst those adsorbed by electro-positive alumina were regarded as more acidic. Thus sucrase was believed to be acidic and trypsin amphoteric. The Willstätter school finds, however, that these results are not valid for the enzymes themselves but only for associated foreign impurities. For example, sucrase in the crude state is not adsorbed by electro-negative kaolin, whilst in a state of greater purity it is readily adsorbed by kaolin. Pancreatic amylase can be adsorbed by alumina when in a crude state, but it is no longer adsorbed by special alumina gels when in a state of greater purity.

The specificity of enzymes is well marked in several instances. The observations of R. Kuhn are of particular interest in this connexion. He points out that the sucrase of yeast which hydrolyses sucrose and raffinose is a fructo-sucrase, because it attaches itself to the fructose residues in sucrose and raffinose. The sucrase of *Aspergillus oryzæ*, on the other hand, is a gluco-sucrase because it attaches itself to the glucose residue in sucrose : it does not hydrolyse raffinose. Fructose added to a sucrose solution undergoing hydrolysis by sucrase of yeast slackens the velocity of hydrolysis. Glucose, on the other hand, slackens the velocity of the hydrolysis of sucrose by Aspergillus-sucrase.

Willstätter, whilst admitting that W. Ostwald's dictum that catalysis is the acceleration by a foreign substance of a reaction which is already proceeding slowly in absence of that substance, gave a stimulus to research on enzymes, insists that it should not be maintained too dogmatically, since as a dogma it would tend to hinder any attempt to find an explanation of the phenomena of catalysis without intermediate compounds and of the causation of reactions without an influx of energy. Ostwald's conception is easy to understand in the case of hydrolysis of sucrose, maltose, and the fats, and even in certain oxidative changes, but it is difficult to realise in that of some of the desmolases, for example, that of alcoholic fermentation, even when we picture this as a change of oxido-reduction.

When it is considered that these laborious researches are the outcome of but ten years' work, no one can fail to be struck with admiration at the accomplishment of such a feat. Nor is the work the less remarkable when it is examined in detail. The methods of attack that have been devised are of the most ingenious character and have not only achieved their object and carried our knowledge several stages forward, but they have also added indirectly much to the chemistry of the colloidal state of matter.

Highly meritorious as this work undoubtedly is, it still leaves us in doubt regarding the chemical nature of enzymes. Of the true nature of enzymes as substances we know but little. We can only assume their individuality by a knowledge of the reactions which occur in their presence. Their function is to catalyse reactions, and in this respect analogies may be found in the early work of Faraday, Mitscherlich, Berzelius, and others on the catalysis of reactions in inorganic chemistry.

It would seem that in all catalytic reactions the first stage is the combination of the catalyst with the substrate, possibly through the medium of residual affinities. This view is by no means a recent one. It was supported by Fischer and by the work of H. E. and E. F. Armstrong. So far as enzymes are concerned, some idea of the way in which this combination may occur is furnished by the suggestion of Northrop, that, in the case of proteoclastic enzymes, the velocity of the reaction depends not on the dissociation of the enzyme, as postulated by the hypothesis of Michaelis, but on that of the substrate. Thus pepsin, the optimum activity of which is shown in a strongly acid medium, is capable of reacting only with the protein kations and trypsin with the protein anions. Willstätter suggests the existence of a third group of enzymes capable of attacking only undissociated protein molecules, their optimum hydrogen ion concentration corresponding with the iso-electric point of the substrate.

In regard to reactions catalysed by enzymes the question may be asked : Are the final products the result of direct or of secondary changes ? The former is that which has long been assumed, whilst much evidence is being accumulated in favour of the latter. Thus the work of Pringsheim on the hydrolysis of starch by amylase indicates that some of the maltose is produced by the mutation of another disaccharide, and more definite evidence has recently been brought forward by Pictet that this disaccharide is one of the γ class. In my own laboratory, work is in progress which confirms this both in the case of starch and of glycogen. Willstätter had not overlooked this possibility. He says :

" The catalyst may function in degrees of association with the substrate, varying from *fixation* to *approach*. It can naturally without extraneous energy bring about a change of constitution in the substrate molecule, and it is only through this

constitutional change that reaction may be induced. Here it is not essential, nor even a general condition, that the molecule should change to a new compound capable of independent existence, as, for example, to an isomeride such as the so-called γ-glucose (with a changed oxygen bridge) which has been postulated as an intermediate in the action of F. G. Banting and E. H. Best's insulin on glucose. . . . F. Haber (1922) considered the heterogeneous catalysis of gas reactions to be a process in which the first phase . . . is apparently represented by an electro-dynamic distortion of the molecules by the atomic fields at the interface between the solid contact substance and the gas. M. Bodenstein also bases an explanation of the activation of hydrogen by platinum on the deformation of the molecules."

Again, considering the chemical nature of enzymes as substance, are they to be regarded as single substances, or are they not rather a system? There is much to be said in favour of the latter view. Despite repeated attempts—none more numerous than those carried out by the Willstätter school—no one has succeeded in preparing a single pure substance from enzyme preparations, possessing activity which characterises these agents as a class. The most highly purified preparations—judging purity by the increased velocity of the reactions they catalyse—have always been mixtures. Moreover, purification by adsorption always stops at a certain point. The classical researches of Harden showed that zymase, or rather yeast juice, may be resolved by ultra-filtration into an inactive thermo-labile colloidal portion and an inactive thermo-stable portion which passes through the filter. The active enzyme is reproduced when these two portions are reunited. The case of trypsinogen may also be cited. This only becomes active trypsin when brought in contact with the enterokynase of the duodenum, which may owe its activating power to the presence of calcium ions. Willstätter in 1922, summarising his views on the nature of enzymes, states that he considers them to be composed of a specific active group which enables them to be combined with the substrate, the composition of which at the same time determines the colloidal nature of the entire complex.

It would seem that researches on enzymes have now been carried to a conclusion so far as is possible with methods at present at disposal. We must patiently await the devising of new means of attack before the problems can be carried to a further stage. Meanwhile universal gratitude must be expressed to Prof. Willstätter and his co-workers for having taught us so much on one of the most intricate problems in the whole range of biochemistry.

ARTHUR R. LING.

Memorials of Galileo.

Memorials of Galileo Galilei, 1564–1642 : Portraits and Paintings, Medals and Medallions, Busts and Statues, Monuments and Mural Inscriptions. By J. J. Fahie. Pp. xxiv + 172 + 47 plates. (Leamington and London: The Courier Press, 1929.) 30*s*.

FEW figures have so struck the imagination of the world as the aged and infirm Galileo. Repressed by the power of the Inquisition, humbled into submission by the temporal power which crushed those deeper stirrings of the human spirit that were leading men to new conceptions of the universe and of man's place therein, "My name is erased from the book of the living", he wrote to his loved daughter. Yet through well-nigh four centuries the roll of his disciples has not closed.

Not least in devotion has been the author of the finely produced volume now before us. Mr. Fahie's engineering knowledge and long experience in Italy have given him an intimate appreciation of much of Galileo's achievement. Yet more fundamental to his work have been the affection and veneration which Galileo has inspired in him. Mr. Fahie has devoted years to the study of his master, and he became the chief collaborator of the late Prof. Favaro in the preparation of the great national edition of the works of Galileo published by the Italian Government. English readers are already indebted to Mr. Fahie for his volume, "Galileo, his Life and Work", published as far back as 1903, and for his study of "The Scientific Works of Galileo" in 1921. Probably no other man now living is equipped with the knowledge which makes these "Memorials" a volume full of charm and interest as well as an authoritative reference book on its subject.

Every authentic portrait of Galileo finds a place in this volume. The sources of prints as well as of paintings have been traced, and errors and false ascriptions have been hunted down and exposed. Moreover, a lifelong study has been rewarded by more than one important new discovery. The ground is covered with great completeness. The work is divided into six parts : Portraits from life ; subject pictures ; medals and medallions ; busts and statues ; monuments and mural inscriptions ; and finally, an entertaining appendix on spurious Galileos.

The work is prefaced by a graceful and illuminating character sketch. In few words there is placed before us what we may call the domestic background of the great philosopher, his fondness for gardening, his familiarity with masterpieces of

classical literation, his generosity, his hospitality, and his love of music. Very touching was the devotion of his pupils, especially of the youngest, Vincenzio Viviani, who as a lad of eighteen came to live with the master in 1639, six years after the historic sentence had been promulgated in Rome. A relationship of warm affection was almost immediately established between Galileo and this lad, who became in his turn a leader of the science of the next generation. To Viviani, too, we owe much of our knowledge of the brilliant circle of young men who in the first decade of the seventeenth century formed in Rome the Academy of the Lynx. This was by far the earliest society for the study of natural science, and very early in its career was honoured by the adherence of Galileo.

One of the discoveries of Mr. Fahie is in connexion with a bust of Galileo by Caccini, which was to have been executed as a gift from Salviati for Prince Cesi, the founder and the first president of the Academy of the Lynx. Owing to the death of Caccini, the marble bust was never made, but Mr. Fahie has traced the original plaster model by Caccini himself which now reposes in the Master's Lodge at Trinity College, Cambridge!

Among the things that will strike the reader of Mr. Fahie's beautiful volume is the great number of contemporary portraits. One of the most remarkable and least familiar is that produced from a crayon drawing by Leoni, dated 1624, now preserved in the Louvre. The immense and thought-laden head is here lightened by an expression of benignity in the eyes not always discerned by the artists who set themselves to delineate that countenance. Mr. Fahie reproduces no fewer than four portraits from the hand of Sustermans, but this famous artist did not work on Galileo until after the tragedy of 1633. Three of the paintings were made in 1640. One, and as he believes the original, has been discovered by Mr. Fahie in London in the private possession of Miss V. F. Robinson.

Yet more numerous than the portraits are the later memorials of Galileo. His condemnation by the Inquisition has been the subject of many fine pictures. Many painters have found inspiration in his life in confinement, his thoughts ever occupied by the movements of the heavenly bodies and by the laws of his 'new science' of mechanics. Always he was surrounded by the pupils who venerated him. More than one painter has been stirred to depict the visit of the young John Milton to that venerable figure. Gradually Galileo has become a legend. His name and his achievements have come to hold a special place in the minds of those for whom freedom of thought and speech is a precious human heritage, won with how much suffering and how easily lost!

Medals have been struck and monuments raised in Galileo's honour. In Florence he is commemorated by the Tribuna di Galileo, a department of the Museum of Physics and Natural History. This Tribuna was opened in 1841 and consists of a vestibule, a small hall, and a semicircular inner tribuna. The walls are decorated with frescoes illustrating the achievements of Galileo, while the cases contain instruments with which he won his knowledge. Perhaps no material monument of him is more touching than the bust with inscriptions and representations of his discoveries which Viviani, greatly daring, placed on the front of his own house in the year 1693. Below, a legend for all to see linked the owner of the house with the man whom the Inquisition had condemned: *Monumenti consecrati da Vincenzio Viviani alla memoria del Galileo.*

DOROTHEA WALEY SINGER.

Sex in Savagery.

The Sexual Life of Savages in North-Western Melanesia: an Ethnographic Account of Courtship, Marriage and Family Life among the Natives of the Trobriand Islands, British New Guinea. By Prof. Bronislaw Malinowski. Pp. xxiv + 506 + 96 plates. (London: George Routledge and Sons, Ltd., 1929.) 42*s*. net.

ALREADY the admirable volume under review has created an interest far wider than its primary appeal to professed anthropologists would indicate, and it may confidently be claimed for it an established place as a sociological classic, which in future no serious student of culture in its broadest terms will be able to pass by.

So slight, and for the most part unmethodical and unscientific, have been all previous studies of the sexual life of primitive peoples in the English language, that Prof. Malinowski's becomes the first really important work in this line of research. In previous volumes he had led up to this more detailed and embracing study by discussing special problems in psychology and sociology, for example, the Freudian incursion into cultural anthropology, and, in other volumes, primitive law, economics, myth, religion, and folk-lore. Other workers approaching these subjects from outside have too often muddied the stream of knowledge and theory by speculations and reconstructions not based on observable facts.

In this volume we are given a very full and

detailed picture of the erotic and family life of Trobriand Islanders. It is, of course, apparent that what is typical of Trobriand tribesmen is not necessarily typical of primitive communities, or even of all Melanesians. Here we are studying a mother-right and matrilineal community in which a man inherits from his maternal uncle, in which the real father's part in procreation is shown to be as unknown as the late Sir Baldwin Spencer showed it was unknown amongst the Arunta of Australia, in which, subject to certain exogamic and kinship taboos, prenuptial and even prepuberal sexual intercourse is almost unrestrained. In every instance where he is dealing with the beliefs and practices of the natives, the author's peculiarly intimate knowledge of the language, his own psychological penetration and his familiarity with a mass of comparative material, enabled him, not merely to state custom and belief in native terms, but also to demonstrate how logically they do arrive at those beliefs. For example, the native refusal to believe that sexual intercourse is necessary to procreation is applied to their theories on the breeding of pigs. The male function is merely to 'open up' by hymeneal penetration and prepare the channel of ingress for the spirits, which are the real fertilising agents. In defence of this belief, the natives point to the free sexual life of unmarried girls and the comparative absence of illegitimate children. Since, they argue, all women, married or unmarried, have either husbands or lovers, but only some have children, the father's part cannot be essential.

In this connexion we touch on a problem of some biological importance, the solution of which lies, as Prof. Malinowski avers, outside the scope of his work. It is one, however, which I have had under consideration as the result of observations made amongst other Pacific peoples. Where, as in the Trobriands, prenuptial intrigues are the rule, illegitimate births are none the less discountenanced, and, by all the evidence, in any case, remarkably rare. The common and easy explanation that unmarried mothers practise abortion, or that some unanalysed and mysterious form of contraception is practised, is quite unsupported by any evidence in the communities in question. This latter popular explanation is particularly inappropriate in the Trobriands, where the fertilising function of seminal fluid is unknown. Yet girls habitually begin an active sexual life from the time they are still quite small children, and, until they marry, remain sterile. After they marry they breed and are often prolific. In the Trobriands, if, as rarely happens, an unmarried girl becomes pregnant, her lover, so far from then being more inclined to marry her, would on the contrary at once repudiate her; not, of course, because of any suspicion of a rival's responsibility, but simply because it is a violation of custom and even more discreditable for an unmarried girl to have a child than for a married woman to remain sterile. The only explanation that I am inclined to put forward touches the postulated law that monandrous matings only are favourable to fertility. The mechanism of it may, it is suggested, be discovered to lie in the autotoxitous properties of spermatozoic saturation. The experiments still being carried on in California and elsewhere in spermatoxins and sterilising serums, associated with work begun by Dittner, Guyer, and others, may eventually reveal the true physiological or biochemical explanation. Meanwhile, a study of tertiary sex-ratio variations will illustrate the world-wide tendency for the substitution of monandrous and polygynous groups for polyandrous groups in a population. This substitution occurred quite clearly, for example, in the Toda population in recent years. We may see here its bearings upon the institution of marriage and polygamy. This question is one amongst many showing the need for a closer collaboration between sociological, demographic, and biological researches.

Here and there the author has to touch on the gradual changes brought about by the influence of contact with European civilisation. Often this influence is exercised deliberately and directly by government officials and missionaries determined to reform and 'uplift' the morals of the debased savage. In almost every instance that influence has been harmful and has resulted in the weakening or destruction of the morality that once existed. The segregation of sexes on plantation compounds and mission stations has lead to homo-sexual practices previously practically unknown; violation of the taboo on incest is now brazened out, where exposure would formerly have led to suicide; missionary attacks on native polygamy and the institution of the boys' houses, *bukumatula*, have merely helped to make adulteries more easily accomplished without punishment, have undermined the power of the chiefs, and disintegrated society. A new cynicism and hypocrisy is the chief lesson the white man's religion teaches.

Mr. Havelock Ellis, in his preface, makes an eloquent plea for a full and scientific consideration of the underlying sexual facts in all sociological inquiries, free alike from the traditions of Anglo-Saxon Puritanism and the almost equally

unfortunate reactions to which the revolt against those traditions may lead. After a study of Prof. Malinowski's work, we may indeed be inclined to think Mr. Ellis's statement that " Sex-taboos weigh at least as much on the civilised as on the savage mind " an under-statement.

GEORGE PITT-RIVERS.

Our Bookshelf.

West African Secret Societies : their Organisations, Officials and Teaching. By Capt. F. W. Butt-Thompson. Pp. 320 + 12 plates. (London : H. F. and G. Witherby, 1929.) 21*s.* net.

THE West African secret societies, according to Capt. F. W. Butt-Thompson, fall into three groups : the mystic and religious, the democratic and patriotic, and the subversive and criminal ; some are ancient pagan institutions, others are Mohammedan, there is a group of Mohammedan-pagan societies, and there are more modern ones. The various aspects and activities of the societies, such as organisation, officials, initiation, religious teaching, etc., are given in appropriate chapters with reference to particular societies ; thus the reader can appreciate what factors are common to most of them, and so is enabled to gain a bird's-eye view, as it were, of their general functioning. Finally, there is a very brief account of each society.

This is the first systematic book on the subject, and the author is to be commended for the considerable amount of information here summarised. Judging from the bibliography, he has searched diligently through the literature which has any bearing on his subject, and he appears to have got into friendly contact with many Africans in the different countries of which he treats, especially in Sierra Leone, but unfortunately there is no indication concerning what is due to original observation and what is taken from published sources, so there is no means of gauging the reliability of the statements here made.

It is a book that tells in brief many things about which we should like to know more, and though Capt. Butt-Thompson records such information as may be obtained by a white man concerning the old social discipline and morality, there must be much more of which probably only an African can enlighten us. As in many primitive communities, some of the ethical teaching, such as that given on pp. 208-9, is good enough for any people to practise, however advanced their scale of life ; for example, " Respect and obey your father and mother ". " Be just to your enemy ; rescue him when he is in danger, and never go out of your way to get him into trouble." " Stealing is undignified ; if you covet a thing, ask for it ; if it is refused, go without it." A people that preaches these maxims cannot lightly be dismissed as ' heathen ', nor can their secret societies always be branded as ' wicked '. The author makes us wish that we could get into real and close touch with the teachers of these doctrines, and work out with them a better and a fuller way of combining their knowledge and aspirations with our own for the benefit and advance of the African. A. C. H.

The Private Life of Tutankhamen : Love, Religion and Politics at the Court of an Egyptian King. By G. R. Tabouis. Translated by M. R. Dobie. Pp. xxiii + 322 + 16 plates. (London : George Routledge and Sons, Ltd., 1929.) 15*s.* net.

To attempt to recreate the atmosphere and reconstruct the conditions of a whole period of history so remote from our own times as the XVIIIth dynasty of ancient Egypt, requires considerable courage. It is a task to which the genius of the French language is perhaps more readily adaptable than our own. Certainly in one or two places this translation of Mlle. Tabouis' book on Tutankhamen carries less conviction than it would in the original. On the whole, however, it is a sound and informative piece of work such as should appeal strongly to the general public. The period with which she deals is one of the relatively few epochs in Egyptian history possessing an individuality and a character comprehensible by a reader who is not already acquainted with the phases of development of Egyptian culture in some detail.

An account of Akhenaton and his religious and social reforms necessarily occupies a prominent place in the book, which is thus given a certain dramatic unity, so much so that, instead of a life of Tutankhamen, it might well be regarded as the story of the rise and decay of the materialised ideal of a political and religious dreamer. M. Theodore Reinach contributes a preface, which is illuminating in the way it sets out in a few paragraphs the distinctive characteristics of Egyptian political development, which play so large a part in the history of Akhenaton's reforms, and also in giving the historical perspective necessary to appreciate the place of the XVIIIth Dynasty in Egyptian history.

The Life of Space. By Maurice Maeterlinck. Translated by Bernard Miall. Pp. 171. (London : George Allen and Unwin, Ltd., 1928.) 6*s.* net.

SINCE the publication of work on the theory of relativity during the War made this subject one of popular interest, there have been many attempts to interpret the significance of the theory in its relation to everyday life. The problem of the fourth dimension is one which occasionally is transformed from the symbolical language of mathematics to the imaginative fancy of popular writing. It is therefore with added interest that one turns to a book of this description by Maurice Maeterlinck. The work is divided into five sections, but the first one, namely, that of " The Fourth Dimension ", is the longest and gives various references to writers who, like Hinton and Ouspensky, have devoted considerable thought to the implications of the fourth dimension. Maeterlinck then deals with " The Cultivation of

Dreams" and makes particular reference to dreams as premonitory phenomena. The following section is headed "The Isolation of Man" and raises the question of whether the mind may acquire the sense of the fourth dimension, thus being liberated from our present human environment. The book concludes with two short articles on "Marvels of Space and Time" and "God". The subject dealt with is, of course, a very wide one and lends itself to much speculation, and among the great number of names to which reference is made we find those of Eddington and Whitehead.

Old Mother Earth. By Prof. Kirtley F. Mather. Pp. xiv+177+59 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1928.) 11*s.* 6*d.* net.

IN view of conditions in Tennessee, where scientific evidence and spiritual exposition continue to be confused with unfortunate public results, it is not surprising that popular American books on geology are still seriously exercised with the views held in ancient Palestine thousands of years ago. Prof. Mather has faced the issue very tactfully in this entertaining volume, which is based on a series of radio talks delivered at Boston. The topics dealt with include the origin of the earth; the evolution of life; the Great Ice Age and its causes; earthquakes and mountain building. All are adequately dealt with, and we are glad to see that the tidal theory of Jeans and Jeffreys is not overlooked in the discussion of "How the World was Made". The treatment of glaciation is excellent, particular pains being taken to prove that the equator had the same relation to the mountains of western America as it has to-day. The illustrations are numerous and effective, and are enlivened by reproductions of medieval representations of Jehovah at work taken from the "Nuremberg Chronicle" of 1493. The book is a well-written and trustworthy introduction to geology, and may be cordially recommended to all who are interested in the lore of the earth as students or teachers.

The Pressure Pulses in the Cardiovascular System. By Prof. Carl J. Wiggers. (Monographs on Physiology.) Pp. xi+200. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 14*s.* net.

WRITTEN in response to the wish of the late Prof. Starling that the writer should analyse "in the briefest possible manner, the present state of our knowledge concerning the pressure pulses in the cardiovascular system", it is impossible to indicate in a paragraph more than the purpose of this book, and to commend the thoroughness and care with which the work has been done. The elucidation of the dynamics of some relatively simple physical system frequently entails much preparation and ingenuity in experiment. The first chapter of this work will indicate to the curious how vast and intricate a preparation has gone to the study of the dynamics of the animal cardiovascular system. There has developed a technique which not more than ten investigators have mastered. "We cannot deny that the circulation of an animal is affected adversely by such experimental influences as artificial respiration, anæsthesia, hæmorrhage, nerve stimulation, exposure of heart and lungs, insertion and fixation of cannulæ. We can nevertheless maintain that it is quite possible to obtain circulatory conditions which appear to be normal to all criteria which we are able to apply." Such an assertion argues a great confidence in an investigator, a confidence which, if justified, marks a great victory for ingenuity over the difficulties of animal experiment.

Contributi del Laboratorio di Statistica. Serie Prima. (*Pubblicazioni della Università Cattolica del Sacro Cuore, Serie ottava: Statistica*, vol. 3.) Pp. vii+436. (Milano: Società Editrice "Vita e Pensiero", 1928.) 50 lire.

THIS book contains the researches of statisticians of the laboratory directed by Prof. M. Boldrino, on a varied group of phenomena, for example: the eugenic effect of wine consumption; passenger traffic on Lake Maggiore; the proportion of the sexes at conception and birth; death from a single cause; progressive paralysis in malaria districts. Among such a miscellaneous group of subjects one can find a certain unity due to the method of treatment and to the work being the product of a single laboratory. Some of the conclusions drawn from the statistics employed are very interesting.

(1) That alcoholic intoxication appears to have serious consequences only at a rather advanced age, so that its eugenic effect should be small.

(2) That the human sexes are conceived in equal numbers.

(3) That the relative frequency of progressive paralysis in malaria districts is high and tends to become less in those districts where malaria is less rife. This is curious in view of the successful treatment of progressive paralysis by inoculated malaria.

Sunrays and Health. By Ronald Millar, in collaboration with Dr. E. E. Free. Pp. vii+125. (New York: Robert M. M'Bride and Co., 1929.) 1.50 dollars.

THIS small volume gives a popular account of the physics and therapeutic uses of light, with special reference to the ultra-violet rays. The text is in a conversational and simple style, and although certain details refer more especially to the continent of America, it can be recommended for perusal by anyone who wishes to have some knowledge of the uses and abuses of a much-advertised remedy. The author gives simple instructions for sun-bathing and points out the dangers of over-exposure: burning the skin is deleterious and unnecessary as a prelude to a becoming tan. He also points out the advantage of exposure to sunlight or skyshine in the open air with the accompanying effect of the cooling power of the air on the skin resulting in stimulation of metabolism and benefit to health. For those who wish to expose their skin to ultra-violet rays during the winter, directions for time of exposure and distance from the lamp are given. In conclusion, this is a sane and readable account of a natural remedy which many are inclined to take in excessive doses.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Low Atomic Energy Levels for Elements of the Oxygen Group.

FROM spectral theory it is known that the lowest energy states for atoms of the oxygen group form a stable triad designated as $^3P_{012}$. Next higher to these is a metastable state $^1D_2$ and next to that again a metastable state $^1S_0$. For oxygen atoms the state $^3P_1$ expressed in frequency units is known to be 67 cm.$^{-1}$ higher than the state $^3P_2$ and the state $^3P_0$ 158 cm.$^{-1}$ higher than the state $^3P_1$. The states $^1D_2$ and $^1S_0$ have not hitherto been evaluated for oxygen atoms.

In the course of a recent investigation of the spectra of selenium and tellurium, we were able to identify all the energy levels $^3P_{012}$, $^1D_2$ and $^1S_0$ for the neutral atoms of both elements. The results are given in the following table :

	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Oxygen	0	67	225	97	10587	28512
Energy differences				10490	17925 λ5577·341 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Sulphur	0	398	572	323	9523	25723
Energy differences				9200	16200 λ6300 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$	$^1S_0$
Selenium	0	1991	2535	1509	9576	23370
Energy differences				8067	13794 λ7247·5 A.	
	$^3P_2$	$^3P_0$	$^3P_1$	^3P mean	$^1D_2$	$^1S_0$
Tellurium	0	4707	4751	3153	10559	23199
Energy differences				7406	12640 λ7909·2 A.	

For tellurium it will be seen the terms $^3P_{012}$ are partially inverted, $^3P_1$ being higher than $^3P_0$. Mean values for the energy levels $^3P_{012}$ are 1509 cm.$^{-1}$ for selenium and 3153 cm.$^{-1}$ for tellurium. If we consider the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2)$ we obtain the value 0·585 in the case of selenium and 0·586 in the case of tellurium.

From observations made on the Zeeman effect with the oxygen green line λ5577·341 A. and described by Prof. McLennan in his Bakerian Lecture (NATURE, July 7, 1928, p. 38, and *Proc. Roy. Soc.*, No. A 785, vol. 120, p. 327), it became definitely known that the auroral green line λ5577 A. originates in electronic transitions between the metastable states $^1S_0$ and $^1D_2$ of oxygen atoms. It has a frequency, therefore, given by $\nu = {}^1S_0 - {}^1D_2$ which, expressed numerically in frequency units, is equal to 17924·7 cm.$^{-1}$. If we suppose that the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2) = 0{\cdot}585$ be applicable to the spectrum of oxygen as well as to the spectra of selenium and tellurium, we obtain 10490 cm.$^{-1}$ and 28415 cm.$^{-1}$ for the mean energy difference $^1D_2 - {}^3P_{012}$ and $^1S_0 - {}^3P_{012}$ for oxygen atoms. From this it follows that the radiation corresponding to the electronic transitions $^1D_2 - {}^3P_{012}$ in oxygen should have a mean wave-length of approximately λ9530 A. and that corresponding to the transitions $^1S_0 - {}^3P_{012}$ an approximate wave-length of λ3520 A. This means that we should expect to obtain in the spectrum of the polar aurora and in that of the light of the night sky a close triplet in the neighbourhood of λ9530 A. and a similar one in the neighbourhood of λ3520 A., the separations in both cases being 67 cm.$^{-1}$ and 158 cm.$^{-1}$. Up to the present such radiations have not been observed either in polar or non-polar auroral light or in the spectrum of atomic oxygen. They should, however, be carefully looked for and experiments in that direction are now being set in train by one of us.

From the numbers given in the table above it will be seen that the lines in the spectra of selenium and tellurium analogous to the auroral green line of oxygen have the wave-lengths λ7247·5 A. and λ7909·2 A. respectively. Moreover, by extrapolation from the numbers given in the table, one is led to the view that a line in the spectrum of sulphur analogous to the auroral green line of oxygen should have an approximate frequency of 16200 cm.$^{-1}$ and an approximate wave-length of λ6300 A.

J. C. MCLENNAN.
M. F. CRAWFORD.

The Grant of Invalid Patents.

THE trend of the excellent leading article in NATURE of Nov. 9, on " The Grant of Invalid Patents ", is to recommend that more power be entrusted to the Patent Office because of the great evil of expensive patent litigation, but in the course of the article two statements occur which I submit are misleading. The writer says (1) that opposition proceedings before the Comptroller are coming to be used as a cheap method of obtaining an official opinion of validity. Now I believe it to be beyond dispute that the Comptroller's decision has no importance whatever as a certificate of validity, and validity is not a question with which he is at all concerned at the hearing of the opposition proceedings. Definite grounds of opposition are laid down by sec. 11 of the Act, and with them he is alone occupied.

Prior publication and prior grant may be, and are commonly, an issue before him, but his decision on these points merely amounts to saying that he cannot find the applicant's invention expressly stated in other specified documents which are put before him, and his decision on the point has no weight whatever in a subsequent action in the High Court.

Secondly, the writer says that the *quale* of subject matter is already handled by the Patent Office. This is only true in the limiting sense that the Patent Office will not grant a patent for something which is *manifestly* not a manner of manufacture, for example, a system of indexing *or* a medical treatment, even though it was described as a " method of extracting lead from men ". Yet with this limitation any experienced patent agent will say that it is nearly always possible to get an invention through the Patent Office.

Space does not permit me to enlarge generally on the other point of view, though on it there is much to be said. There is the danger of allowing Patent Office officials, excellent and efficient as they are, to decide academically and without proper evidence on what are after all practical questions—I say without proper evidence, for a full-dress trial at the Patent Office would, except for the comparatively small court charges, be as expensive as a trial in the High Court. Again, Patent Office ' mistakes ' would be serious, for they would mean that improper grants were made, or that grants were improperly refused. So far as the lawyer is concerned, it might well happen that although the excessive cost of patent actions was reduced there would, nevertheless, be a very much greater number of small patent actions!

Is it not true, however, that the real cause of the expenses of the big patent actions is not so much the law as the exceeding complexity of modern science and technical knowledge, coupled with the immense financial interests which to-day exist in business?

CARROL ROMER.

5 Crown Office Row, E.C.4,
Nov. 11.

MUCH of the leading article in NATURE of Nov. 9 involves the assumption that the purpose of patents is to encourage inventions, or even inventors. There may have been a time when that was true, though it must be remembered that the grant of a monopoly was originally a bribe for the disclosure of an invention, not a reward for making it; but it belongs to the remote past. It was a time when the same person could be inventor, workman, foreman, manager, and director, when organised research was unknown, and industry progressed unforeseeably by discontinuous mutations. In the completely different economic and intellectual atmosphere of the modern world, the patent machine has ceased to work according to the intentions of its designers and cannot fulfil the purpose for which they designed it. With our admirable English adaptability, the envy of all foreign observers, we have converted it to other purposes, not less vital to the community. Patents now serve to provide financiers with convenient weapons for their mutual warfare, and patent agents with a living.[1] The British Science Guild wisely recognised the change when it constituted its Patents Committee mainly of those who regard an invention merely as the occasion for the issue of a legal document. Industrial scientists would be wise to recognise it too.

For in these days of trade unionism and rationalisation, no tinkering with patent law can enable an isolated inventor to fight an industry. In particular, what is the good of deciding the issue of validity once for all in the Patent Office, when the closely related issue of infringement cannot possibly be decided until it arises? The Patent Office may declare generally that the patent claims something validly, but that something can only be defined by particular instances. Attempts to deprive wealth of its influence in one direction only drive it to seek influence in another, and the search is never long; as many have asked before, if there were really justice between rich and poor, what would be the use of being rich? Instead of claiming rights of which the evolution of society has deprived us for ever, let us make the most of those that it has newly conferred on us. When the foundations of the patent law were laid, no one could earn a salary by indulging his disinterested curiosity.

NORMAN R. CAMPBELL.

155 Hagden Lane,
Watford, Herts.

IN reply to Mr. Carrol Romer's letter: it certainly is true that the Comptroller cannot give a certificate of validity or tie the hands of a higher court. The leading article was not intended to convey that impression at all. But it is also a fact that the carefully reasoned decisions, commonly running into 5000 or 6000 words, which are nowadays a feature of opposition proceedings, help the parties to see exactly where they stand, and often enable them to come to terms. In the event of an appeal, time (and therefore expense) is saved in the appeal proceedings by the Comptroller's preliminary elucidation of the issues. Does Mr. Romer seriously maintain that the grounds of opposition are irrelevant to validity?

Mr. Romer seems to hold the view that the Comptroller does not enforce amendments, or otherwise exert his powers, except in such extreme cases as that in which an invention has been wholly and specifically described in a prior publication. That view is directly contrary to the writer's experience. There has been a strong tendency, especially in recent years, for the Comptroller's court to deal quite courageously in realities and not merely in words. Public appreciation of this policy seems to be indicated by the rapidly increasing use which is made of the Comptroller's jurisdiction.

As regards the cost of evidence: an economy would obviously be effected if such issues as documentary anticipation could be kept out of the High Court. Even if matters calling for a good deal of evidence were to be brought within the Comptroller's jurisdiction, a favourable precedent would be found in opposition proceedings based on the plea of 'obtaining'.

In his last paragraph Mr. Romer surely is right in attributing the increasing cost of patent litigation to the increasingly scientific and technical character of industry. It follows that the High Court is ceasing to be a suitable place for the trial of many of the issues which affect validity. A judge's time is too valuable to be properly taken up with those cramming-courses in chemistry, physics, and applied mechanics through which the expert witnesses have to coach him; and patent law forms such a small fraction of the whole body of law that a technical training is more appropriate than a purely legal training for men who have to decide questions of technical fact. It is true that if mistakes made in the granting or refusal of a patent were to be rendered irrevocable, grants would be improperly made or refused, and that would be a serious evil. But the existing state of things is an incomparably *more* serious evil. The risk of minor injustices is preferable to the actuality of major abuses.

Dr. Campbell's statement that "the grant of a monopoly was originally a bribe for the disclosure of an invention" appears to require revision in view of the actual history of the matter. The writer is inclined to agree, however, that if the minds of the British Science Guild Committee had not been biased by a practical knowledge of their subject, their report would probably have been characterised by a high degree of novelty, though it might have fallen short in point of subject-matter and utility.

After all, the battle is not always to the strong, even under existing conditions. If the patent system were to be 'tinkered up' with courage and foresight, the duration of High Court proceedings might be considerably shortened, and then the salaries to be gained by indulgence in disinterested curiosity might come to be levelled up to a more satisfactory general average than that at present available.

THE WRITER OF THE ARTICLE.

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[1] The fees paid to a few leading counsel always attract attention, but the fees paid to patent agents are much larger in aggregate; their function, if patents had retained their original purpose, would have been equally parasitic.

The Permeability of Plant Cell Membrane to Sugar.

THIS communication deals with a glucose effect on the permeability of cell membranes to sugar molecules as studied by the intensity of respiration when leaves of *Artocarpus Integrifolia* were injected with varying concentrations of glucose solution. The investigation developed as a very interesting by-product of other investigations on respiration. Though the important

rôle of carbohydrates in the physiology of the living cell has been recognised for a very long time, our knowledge concerning the direct penetration of living cells by carbohydrate molecules is only recent. Scarcely anything is known, however, about the effect of sugar on the permeability changes of cell membranes to diffusion of sugar molecules. Curiously, the direct evidence for an effect of this kind of sugars on the permeability of cell membranes is obtained from an investigation which had primarily nothing to do with the problem.

The investigation was concerned primarily with the study of respiratory intensity when starved and unstarved leaves were injected with varying concentrations of glucose solutions. The curves obtained in that connexion could not all be explained on the basis of a simple relationship between concentration and respiratory intensity, for which an explanation had to be sought.

Observations of the rates of respiration were recorded on the control and the experimental leaves simultaneously. For purposes of analysis, from the curves thus obtained the per cent algebraical increase of respiration of the experimental leaves over the controls have been calculated and exploited.

The equations for the curves of the hourly march of these values work out in a very simple way in the majority of these curves. They can be expressed as simple logarithmic curves.

For comparing the relationship between the concentration of sugar solutions and the respiratory intensity, the *initial* values obtained by extrapolating these curves to zero time have been plotted against the corresponding concentrations.

The generalised curves thus obtained at different temperatures show an ascending and a descending phase. It is the ascending phase which forms the special feature of this communication. This phase shows the mathematical relationship $R = K.Ct^n$, where R is the rate of respiration, Ct the concentration, K a constant, and n an index which is greater than unity, that is, respiration increases relatively more as concentration increases. This is explained in terms of the relatively greater rate of diffusion of sugar molecules as concentration increases. The only way in which this can happen is through variations in the permeability of cell membranes to the diffusion of sugar molecules as the concentration of glucose solution increases, thus supplying direct evidence of the effect of glucose on the permeability of cell membranes.

In the equation given above, K represents the diffusibility factor for the diffusion of sugar, which would vary at different temperatures, and the index n the factor for variations in the permeability of cell membranes as the concentration of the solution increases.

In view of these results, the effect of various carbohydrates on the permeability of cell membranes must be known before one can investigate their quantitative effects on various physiological processes of metabolism, such as respiration, etc.

R. S. INAMDAR.
K. V. VARADPANDE.
Benares Hindu University, India,
Oct. 20.

A Lantern Slide Model of the Wave Electron.

LECTURERS on the more popular aspects of the wave-electron may be interested in a simple lantern slide model for demonstrating the waves which I have not seen previously described. Based directly on an explanation given by de Broglie in his "Recherches sur la Théorie des Quanta" (*Ann. de Physique*, **3**, p. 22; 1925), it has the advantage not only of showing the waves to an audience, but also of giving perhaps some insight into their nature. The model consists merely of the diagram of lines shown in Fig. 1, which can be pushed horizontally in the lantern behind a fixed vertical slit.

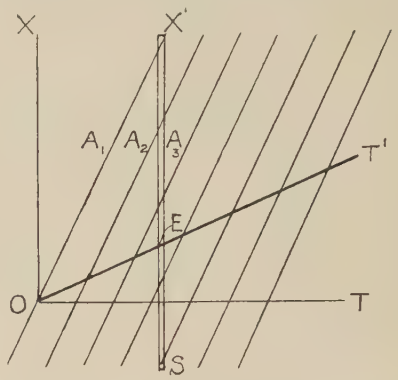

FIG. 1.

The figure represents the space-time diagram of the observer of a moving electron. The observer is represented by the successive points of his time line OT, while of his space axes only OX is drawn. The time line of the electron, in motion with respect to the observer parallel to OX, is OT^1. Now the electron has a known energy, $w = mc^2$, which on the electromagnetic theory is spread out in space round it, and also associated with the electron in some way (perhaps it is rotating with a fixed angular momentum), an elementary quantum of action, h, has to be admitted. From these known quantities we can deduce a certain time,

$$\tau = \frac{h}{w}$$

(8×10^{-21} sec. for slow motion), and the diagram can be divided into cells, each containing the action h, by lines separated by intervals τ (measured along OT). These lines, representing instantaneous spaces associated with the electron, must be drawn perpendicular to OT^1. It is, however, a well-known feature of the pseudo-Euclidean geometry of space-time that a line which satisfies the analytical conditions of perpendicularity to OT^1 lies actually parallel to OX^1, where $\angle XOX^1 = \angle TOT^1$ when the velocity of light is taken as unity. The lines, A_1, A_2 . . ., separating the successive action cells, appear consequently as shown.

Now when the slide is covered by an opaque screen with a slit S in it, and the diagram is moved behind it from right to left, we see the electron E moving up the slit with the velocity v, while a train of phase waves, formed by those parts of the lines between the cells of action which show through the slit, passes up through the electron with a velocity c^2/v in a very realistic way. Transparent lines on a dark background give the best effect. S. R. MILNER.

The University,
Sheffield.

The Subdivisions of the Order Primates.

IN his Croonian Lecture on "The Developmental History of the Primates", Prof. J. P. Hill referred to the late Dr. Hans Gadow's subdivision of the Primates into three sub-orders for reasons which I have previously explained in some detail (NATURE, May 2, 1907, vol. 76, p. 7, and *Proc. Zool. Soc. Lond.*, 1919, published Feb. 1920, p. 465).

My colleague has suggested that I should put on record the circumstances in which Dr. Gadow created the sub-order called by him 'Tarsii'.

In 1898, when Dr. Gadow was preparing for the use of his students the book "A Classification of Vertebrata", the International Zoological Congress was held at Cambridge. He undertook the task of translating and elaborating Haeckel's address to the Congress, which was afterwards published as a book under the title "The Last Link".

In the course of this task Dr. Gadow was faced with the difficulty of bringing into harmony the views expressed at the Congress respectively by Haeckel and Hubrecht. The former regarded the lemurs as ancestors of man and as Primates belonging to the same sub-order as *Tarsius*, whereas the latter wanted to exclude the lemurs altogether from the Primates and to regard the tarsier almost as an Anthropoid. Gadow invited me to Shelford to wrestle with this difficulty, and, after several days' discussion, he decided that there was only one way of effecting a reasonable compromise between the conflicting views. While the lemurs could not be eliminated from the order, they should be separated from the tarsiers. Hence he proposed a subdivision into three sub-orders, which he called respectively Lemures, Tarsii, and Simiae. Several years later (op. cit. *supra*) I brought these terms into closer relationship with traditional usage by calling the sub-orders Lemuroidea, Tarsioidea, and Anthropoidea. My colleague, Prof. J. P. Hill, has still further clarified the position by separating monkeys (which might be called Pithecoidea) from the apes and man (to which the term Anthropoidea might be restricted) as separate sub-orders—a proposal made by Friedenthal more than twenty years ago, the justification for which was graphically expressed in the phylogenetic diagram in my "Evolution of Man".

By emphasising the nearness of man's affinity to the anthropoid apes, this proposal gives expression to a conclusion which recent research in comparative anatomy, embryology, hæmatology, and immunology is making necessary. G. ELLIOT SMITH.

University College,
London, W.C.1,
Nov. 25.

Lankester's 'Gregarine' from the Eggs of *Thalassema neptuni*.

OUR attention has been directed by Mr. A. D. Hobson, of the University of Edinburgh, to a sporozoan that attacks the developing eggs in the genital pouches (nephridial sacs) of the echiuroid worm *Thalassema neptuni* Gärtner. Of twelve females examined at Plymouth this autumn, eight showed a heavy infection. It is clear that the parasite is the 'Gregarine' observed by Ray Lankester in the eggs of one mature female among those he collected on the south coast of Devon and briefly mentioned in a paper published in 1881 (*Zool. Anz.*, Jahrg. 4, p. 250). Prof. and Mrs. Goodrich in their paper on *Gonospora minchinii* (*Quart. Jour. Microsc. Sc.*, vol. 65, p. 157; 1921) refer to Lankester's notes, but no one seems to have investigated further the organism from *Thalassema*.

A preliminary examination has shown us clearly that it is not a gregarine, but a coccidian; and as this is, so far as we know, the first recorded instance of such a parasite within an egg, we propose to work out the life-history in detail.

It is not surprising that Lankester supposed he was dealing with a gregarine, for the trophozoite is a long, worm-like body, 200 μ to 400 μ in length and 16 μ to 22 μ broad. The cytoplasm is densely granular and appears white by reflected light; the pellicle is very thin; the nucleus lies in the centre of the body. At this stage the parasite is coiled up within the egg; sometimes three occur together. When pressed out from its shelter, it shows no movement. The parasitised eggs degenerate and are liable to phagocytic invasion. We believe that we have found the schizogonic phase, in which 40 to 50 merozoites are formed, each measuring about 16 $\mu \times 12$ μ. The gametocytes are spherical, the female larger than the male; occasionally a male and a female lie within the same egg. The males give rise to a very large number of flagellated microgametes. We have not yet found the oocysts or spores, and so cannot at present say anything more precise as to the systematic position of the coccidian.

The only true gregarine we have seen in *Thalassema* is a cephaline form living in the gut, sometimes in company with the ciliate *Ptyssostoma thalassemæ* Hentschel. D. L. MACKINNON.
H. N. ROY.

King's College, Strand,
London, W.C.2,
Nov. 21.

Influence of the Para-Foveal Regions on the Foveal Region of the Retina.

THE following simple experiment shows the above influence in a very conclusive manner. Let a piece of black cardboard eight inches square be taken and place this on a wall paper with a coloured pattern. The light in the room should not be too bright, but the experiment can be done easily in an ordinary room with the daylight of the present time. The black cardboard should be viewed with one eye at a distance of six feet, the eye being kept as immovable as possible. It will then be noticed that portions of the colours of the wall paper will appear to detach themselves from the wall paper and move with a slow spiral motion into the black area. This will go on until the whole black area has completely disappeared, the surface being covered with a mixture of colours similar to those on the wall paper.

If a Persian carpet be used for the purpose of the experiment the area will be covered with a mixture of the colours of the carpet. If a uniform colour be used the black area will be covered by that colour. It may even make another colour disappear. For example, if a piece of red paper an inch and a half square be placed on a piece of yellow-green cardboard the yellow-green will invade the red until only a yellow-green surface is seen. If any difficulty be experienced the reader should try the experiment in a dimmer light, but I have not found anyone, at present, who has not seen the phenomenon with ease. It will be noticed how strongly this phenomenon supports my theory of vision, which I regard as a fact, and it seems impossible to explain it on any other theory. F. W. EDRIDGE-GREEN.

Board of Trade,
S.W., Nov. 19.

Graptolite Centenary.

MY friend Dr. Ami is wrong in supposing that at the University of Birmingham I was associated with the work of Prof. Charles Lapworth on graptolites (NATURE, Nov. 16, p. 766). All that I can claim is to have set him free from some of the routine work of his professorship and thus helped him to find time to undertake more original investigation and writing than he otherwise could have done, including the editorship of the Monograph on the Graptolites, written by Miss Elles and Miss Wood (now Dame Shakespear). W. W. WATTS.

Langley Park Road,
Sutton, Surrey, Nov. 18.

Recent Reactions between Theory and Experiment.[1]

The Raman Effect: The Constitution of Hydrogen Gas.

By Sir Ernest Rutherford, O.M., Pres. R.S.

IN watching the advance of science, and particularly of the physical sciences to-day, one cannot fail to be struck by the very close connexion between theory and experiment—a relation which is probably more intimate than at any other period of scientific history. Every new experimental observation is at once seized upon to test whether it can be explained by existing theories, and if not, to find the modifications necessary to include it in the general theoretical scheme of natural processes. The mathematical analysis often suggests the possibility of unexpected relations which can be made the subject of fruitful experimentation. These two, in a sense, complementary branches of physics profoundly react and interact with each other, and their united efforts lead to a greatly accelerated rate of advance in knowledge and understanding of the essential principles involved. The rapidity of advance in physics, which has been so marked a feature in the last decade, is mainly due to this close combination of theory with experiment.

It will be seen that this interaction is clearly manifest in the subjects which I have selected to speak of to-day. I wish to refer briefly to certain recent discoveries which have excited much interest among physicists and chemists, and have thrown much new light on problems which have long been the subject of close investigation.

The scattering of light by small particles and the 'Tyndall blue' of the scattered light, when white light from the carbon arc or the sun falls on a solution filled with a multitude of small particles, are well known. The late Lord Rayleigh in 1871 first gave the mathematical theory of the scattering of light by such particles, and was able to account in a general way not only for the colour of the reflected light but also for its state of polarisation. He suggested that light should be scattered, not only by particles containing many millions of molecules, but also by the individual molecules themselves, and that the blue of the sky was probably due mainly to the scattering of sunlight by the molecules of the atmosphere in its path.

This suggestion of molecular scattering was strikingly confirmed by the experiments of his son, the present Lord Rayleigh, who showed that scattering of light could be observed in gases freed from all dust nuclei, and that the light scattered perpendicularly to the direction of the incident beam was mainly plane polarised.

In recent years there have been a large number of investigations on the scattering of light, not only by gases but also by liquids and solids, with especial attention to the amount of scattered light and the degree of its polarisation. I shall not refer here to these results and the interesting deductions that have been made from them, but concentrate attention on a more recent development. Sir Chandrasakara Raman, of the University of Calcutta, who had for many years experimented on this subject, made an important observation which has thrown much new light on this question. For simplicity, suppose that monochromatic light of a definite frequency passes through an organic liquid, say, benzene or toluene, which has been carefully purified. It was observed that the colour of the scattered light was distinctly different from the incident beam, showing that the light had in some way been altered by scattering by the molecules in the liquid. To examine this change more accurately, the scattered light was passed through a spectroscope. A striking result was observed. The strongest line was equal in frequency to the incident light, as was to be expected on the classical theory, but in addition a number of new lines were observed on the low-frequency side of the main line, and a few fainter ones on the high-frequency side. By the process of scattering, a set of new discrete frequencies had thus made their appearance. An excellent account of these beautiful experiments was given this year by Raman and Krishnan in our *Proceedings*. Similar effects were observed by Landsberg and Mandelstamm by examining the light scattered by certain crystals.

Such experiments are not easy, for the scattered light is very feeble, and long exposures with intense sources of light are necessary to bring out the relatively faint new lines. An examination of the results showed that the changes of frequency depend on characteristic frequencies of the molecule, connected with its vibrational states.

The interpretation of these results is most clearly seen by consideration of the similar effects in gases, and we shall consider these first. For example, if ν be the frequency of the incident light, the frequencies of the new lines are $\nu - \nu_1$, or $\nu + \nu_1$, where ν_1 is always found to be a difference between two fundamental frequencies of the molecule. This is completely in accord with the quantum theory of scattering, which was given formally by Kramers and Heisenberg in 1925. It is to be presumed that the light scattered by liquids is of the same nature, and the frequency shifts are due equally to differences of molecular frequencies; although in molecules, which absorb strongly in the infra-red, these differences may themselves appear as actual molecular frequencies.

It is of interest to note that the possibility of a process of this kind, involving the appearance of new frequencies, had been predicted by Smekal as well as by Kramers and Heisenberg. While theory and experiment agree admirably for gases, the theory could not have been legitimately extended to the case of molecules of a liquid, and here the Raman effect provides a new and effective tool for determining frequencies which are naturally present in a liquid or a solid.

[1] From the presidential address delivered at the anniversary meeting of the Royal Society on Nov. 30.

It is clear that this new effect may be of great importance in determining the slow characteristic frequencies of molecules in the infra-red, which may be difficult to measure by other methods. This new discovery, of great interest in itself, thus promises to open up a new field of experimental inquiry and to throw valuable light on the modes of vibration and constitution of the chemical molecule.

It is naturally of great interest to consider the processes occurring in the molecule that give rise to these scattered radiations. The action of a train of waves in its passage through the complex electrical system of a molecule, which may be set in vibration in a variety of ways, is naturally very complicated and difficult to explain briefly in simple language. If, however, we content ourselves with a consideration of the energy changes only in the radiation, and disregard the detailed mechanism involved in the radiation processes, a simple explanation can be offered on the ideas of the light quantum.

We start by observing that it is a general consequence of wave mechanics that if a system possesses a number of states of equal energy, there is usually a finite probability of a transition from one of the number to any of the others. Consider a quantum of light, of frequency ν and energy $h\nu$, falling on a molecule in a given direction. The quantum and the molecule are to be regarded as a single system. This system has a number of other states of the same energy. First, those in which the molecule is unchanged and the original quantum is scattered in a new direction without change of frequency; transitions to these states correspond to Rayleigh scattering. Secondly, other states in which the state of the molecule is changed, its energy being altered by $\pm h\nu_1$, while a quantum of light of energy $h\nu \mp h\nu_1$ is scattered in some new direction. Changes to these states correspond to the Raman effect, where frequencies $\nu - \nu_1$ and $\nu + \nu_1$ are observed. The actual changes occurring in the molecule to give rise to these new frequencies can only be inferred from a detailed consideration of the possible modes of vibration of the molecule itself.

I shall now consider a very interesting discovery which has been made in the past year. It has been found that, in a sense, hydrogen consists of two different kinds of molecules, which under ordinary conditions of temperature and pressure behave in a distinctive way; for example, the specific heat and conductivity of the two kinds of hydrogen are very different. The hydrogen molecule in the normal state consists of two nuclei and two electrons. On the ordinary views of the gas-kinetic theory, it is to be expected that the molecules, in addition to their ordinary velocity of agitation, may rotate on an axis perpendicular to the line joining the nuclei. On the quantum theory, it has a series of states of rotation which are specified in terms of a quantum number which has the values 0, 1, 2, 3, etc. Experiments on the band spectrum indicate that in ordinary hydrogen gas at atmospheric temperature the molecules which have rotation numbers 1, 3, 5, are about three times as numerous as those with even rotation numbers, 0, 2, 4, . . . For convenience, the molecules of even rotation number will be termed α-hydrogen, and those with odd rotation numbers β-hydrogen.[2] When in equilibrium, the relative number of hydrogen molecules in the different rotation states at any temperature is governed by the well-known Boltzmann law of distribution and can be calculated approximately. If, however, ordinary hydrogen gas is reduced to a low temperature, say, that of liquid hydrogen, on the ordinary kinetic theory it is to be expected that the rotation of the molecules should practically vanish; that is, the majority of the molecules should have a rotation number 0 and only a small fraction, depending on the temperature, remain in the higher rotational states.

Actually, however, it is found that while α-hydrogen is mainly in the rotation state 0, the β-hydrogen does not change into the state 0, at any rate for a long time, but retains its individuality, although, of course, the ratio of the number of molecules in each odd rotation state is governed by the Boltzmann law. The surprising fact emerges that the β-hydrogen under the influence of ordinary gas-kinetic collisions is only with great difficulty changed into α-hydrogen. The time required for true equilibrium, after lowering the temperature, may be measured in months, or even in years under some conditions. This interval depends, as we should expect, on the pressure and temperature of the gas, since these govern the number and magnitude of the molecular collisions. This means that a molecule with odd rotation number finds a very great difficulty in passing to the even state of rotation.

A general explanation of this can be given on wave mechanics and appears to be intimely connected with the very weak coupling between a rotation state of the molecule with the spin of the minute individual nuclei (protons) which make up the molecule.

While under normal conditions, the passage of β-hydrogen into α-hydrogen and vice versa is excessively slow compared with the duration of an ordinary experiment, yet the transitions can be greatly accelerated by appropriate treatment of the gas. For example, if hydrogen cooled to a low temperature is subjected to an electric discharge, there is a rapid transformation. The passage of the cooled gas through charcoal immersed in liquid air or liquid hydrogen acts in a similar way. When the hydrogen is rapidly cooled to the temperature of liquid air, the odd rotation states are much in excess over the equilibrium value. The passage through the charcoal causes a rapid transformation of the β-hydrogen and the emerging gas at the temperature of liquid air consists mainly of α-hydrogen.

It is of great interest to note that if the gas is warmed to ordinary temperature after passage

[2] The terms 'para'- and 'ortho'-hydrogen have been sometimes used for what I have called α and β. This seems undesirable, since these names are still required to distinguish the *electronic* states in analogy with those of the helium spectrum.

through the charcoal, it remains mainly α-hydrogen, while hydrogen gas in equilibrium consists only of about one-quarter of α-hydrogen. It has been found that the specific heat of the gas and its heat conductivity at the temperature of liquid air before passage through charcoal are markedly different from the values for the gas at the same temperature issuing from the charcoal. In a sense, we may say that α-hydrogen has been obtained by this process in an approximately pure state. The effect in charcoal cooled to the temperature of liquid helium would be even more complete. It seems probable that the rapid transformation brought about by passage through charcoal is catalytic in nature and may quite likely be due to the dissociation of the molecules into atoms and their subsequent recombination to form new molecules.

This striking and unexpected behaviour of hydrogen—the simplest molecule known to us—is of great theoretical as well as experimental interest. It had been known for some time that no satisfactory theoretical explanation could be given of the change of specific heat of hydrogen with temperature, either on the kinetic theory or with the modifications of the theory based on the older form of the quantum theory.

A new orientation of our ideas was given by the development of the wave mechanics theory. One of the first triumphs of this theory was the explanation by Heisenberg of the complex spectrum of helium. The two types of spectra which appeared were shown to be connected with the different directions of spin of the electrons themselves. In one case, the orbital wave functions were symmetrical and in the other case antisymmetrical. From analogy with the behaviour of the helium atom, Hund showed that it was to be expected that the hydrogen molecules should consist of two kinds; in one, which we have called α-hydrogen, the wave functions were symmetrical in the rotational wave function and in the other, called β-hydrogen, antisymmetrical. It was recognised that, on the wave theory, there must be a very weak coupling between the symmetrical and antisymmetrical states, so that the transition from one state to the other must be fairly slow.

Dennison, in a paper published in our *Proceedings* in 1927, calculated the specific heat of hydrogen at different temperatures on the bold assumption that the time of transition from one state to the other was very slow—of the order of one year—compared with the time required for a determination of the specific heat experimentally. Under these conditions, ordinary hydrogen could be considered to be a mixture of two gases, which have not only different specific heats but a different variation with temperature.

By assuming that the ratio of α- to β-hydrogen was 1 to 3, he found that the calculated and observed specific heats agreed over the whole range of temperature. This ratio between the two states of hydrogen was in accord with the observations of T. Hori on the band spectrum of hydrogen.

Experimental proof of the accuracy of this deduction was soon forthcoming by a variety of experimental methods. Prof. J. C. McLennan examined the Raman effect in liquid hydrogen and found that the changes of frequency observed in the spectrum of the scattered light indicated that hydrogen at this temperature consisted of a mixture of molecules having even and odd rotational states. The relative intensity of the lines was in accord with the relative distribution assumed by Denison.

About the same time experiments were undertaken by Eucken and Hiller and by Bonhöffer and Harteck in Berlin. Eucken and Hiller determined the specific heat of hydrogen under different conditions. Hydrogen at high pressure was kept for some days at the temperature of liquid air, the specific heat was measured at intervals and at different temperatures, and was found to show marked variations with time. The fraction of α-hydrogen was found to vary from 25 per cent at the beginning to 95 per cent after a long interval. It was found that the rate of transition from β- to α-hydrogen at liquid air temperature depended on the pressure of the gas and was approximately proportional to the number of molecular collisions.

Bonhöffer and Harteck used a simpler and more rapid method for following the change of state of the hydrogen under different conditions. By measuring the change of resistance of a heated wire in the presence of the gas, the changes in the heat conductivity of the gas, which varies with the specific heat, were easily followed. We have already referred to their experiments of passing hydrogen through charcoal at low temperature and of the effect of the electric discharge. The results of the beautiful experiments of Bonhöffer and Eucken afford a complete and striking proof that hydrogen under ordinary conditions is composed of two sets of molecules which are transformed into each other so slowly that they may be regarded in a sense as two distinct gases differing in specific heat and conductivity. The specific heat of α-hydrogen at low temperature is greater than that of β-hydrogen. A large quantity of heat is given out in the passage of β- into α-hydrogen. At very low temperatures, the heat evolved in this transformation is greater than the heat of volatilisation of liquid hydrogen.

It may be of interest to note that the peculiar behaviour of hydrogen might have been discovered long ago, for no new experimental knowledge or technique is involved. Attention, however, was only directed to this subject by the failure of existing theories to account for the variation of specific heat of hydrogen with temperature. The development of wave mechanics threw new light on this problem and a happy suggestion, based on this theory, was found to fit in well with the observations on the specific heat. Following this clue, the question was attacked experimentally by several different methods, with results in complete accord with the predictions of theory.

Cinchona in the British Empire.

THE value of the cinchona tree (*Cinchona Ledgeriana*) as a source of quinine is common knowledge, but the considerable work undertaken by British medical officers in the past in making use of the product of this tree as a preventive against malaria is not so well known. The cinchona tree was introduced into both India and Java between the years 1854 and 1864. Prior to about 1880, the world's supply of cinchona bark was obtained from the native forests in Ecuador, Bolivia, and Peru. It was only after the export of bark from these regions could no longer be relied upon that attempts were made to grow cinchona elsewhere. The British were amongst the first to succeed in bringing the tree under cultivation. The pioneers were such men as Weddell, Hasskarl, Markham, Ledger, and others, and it was by their efforts that the establishment of important supplies of the drug became a practical proposition.

The early attempts to cultivate the cinchona tree met with considerable success, and private persons took up the business as a commercial proposition. In the early days of cultivation, experiments were made in India, Burma, Ceylon, Malaya, the Sudan, Jamaica, Trinidad, St. Helena, Mauritius, Australia, and New Zealand; but these experiments were not always followed up to a definite conclusion. In Ceylon and India the efforts were successful, but private planting was soon given up and the Government has been mainly responsible for the supplies. Within the Empire, therefore, at the present day, India is the only country where cinchona is grown on a large scale. There are Government plantations in the Nilghiris in the south, in the Darjiling district in Bengal (perhaps the best known), and a more recently developed one in Burma. There are also quinine factories both in the Bengal and Madras Provinces.

A recent paper by Dr. J. M. Cowan, of the Indian Forest Service and officiating Director, Botanical Survey of India, and Superintendent of Cinchona Cultivation in Bengal, entitled "Cinchona in the Empire: Progress and Prospects of its Cultivation" (*Empire For. Jour.*, vol. 8, No. 1 (1929)), discusses the present position of the cinchona and the future prospects of its cultivation.

The enormous importance to the human race within the Empire of the perpetuation of supplies of quinine will become evident when the question of malaria prevention is considered. We have within the Empire a large proportion of the malarial tracts of the world. Prof. Müller of Cologne estimates that some 800,000,000 people suffer from malaria; and according to Sir Ronald Ross there are 2,000,000 fatal cases every year. It is further estimated by Dr. Andrew Balfour that the direct loss sustained by the British Empire due to sickness and death caused by malaria is in the neighbourhood of between £52,000,000 and £62,000,000 per annum.

Apart from financial considerations, it will be apparent that the responsibilities of the British Empire in this question of malaria prevention or reduction are heavy. The question has become an international one, and an organisation for anti-malarial work has been set up by the League of Nations. The policy of this organisation is primarily the quinisation of affected populations. Hence the cultivation of the cinchona tree becomes a question of first importance. It is to a consideration of this matter that Dr. Cowan's paper is devoted.

In India, then, the cultivation of cinchona is confined to Government activities. It was not until 1910–11 that a similar problem had to be faced in Java. Conferences were held, and manufacturers in Holland and growers in Java came to an agreement by which profits were to be shared and by which prices could be maintained at a level which would show satisfactory returns. The disaster which threatened the Java plantations was averted to a great extent by the adoption of this policy; and supplies are now available for the world demands. That the action taken in Java was thoroughly practical, a comparison between the two countries readily demonstrates. They commenced to give attention to the question about the same time and the facilities in both regions were abundant. Yet Java now produces well over 90 per cent of the world's supply of cinchona bark and India only 4 per cent. A very small percentage of the bark utilised comes from South American forests. The production in India represents only about one-third of the amount actually consumed in the country itself. She is therefore at present not only unable to supply her own demands but also, in common with the rest of the world, is dependent upon the Dutch plantations in Java.

Dr. Cowan explains one of the problems which has so far guided the cultivation of cinchona. "It is a well-known fact that to grow cinchona on the same land for a considerable number of years is a difficult and hazardous undertaking, for the first crop, in some manner not altogether understood, renders the soil, at least temporarily, incapable of producing a satisfactory second crop. As long as there is an unrestricted area of forest land the above factor seems of little consequence, but it makes itself felt more and more as the years go on and there is an increasing shortage of land carrying virgin forest."

Dr. Cowan discusses the methods of growing the crop, for details of which the inquirer is referred to his paper. Harvesting the bark commences in a block from about the fourth year, the material consisting of prunings and thinnings. The crop is reaped, the trees being uprooted so as to obtain the maximum of bark, in about the tenth year. The bark is removed, dried, stored, and then passed on to the quinine factory.

Two problems, in the author's opinion, demand urgent solution: the first is to find additional suitable land, an investigation in which other parts of the Empire should join; and the second is to enhance the output per unit of area. Research work is also

necessary with regard to particular strains which yield high percentages of quinine.

The price of quinine at present is very high—£1 9*s.* 6*d.* per lb.—so high as practically to prohibit extensive anti-malarial measures. On this subject the Royal Commission on Agriculture in India in its report (1928) stated: "If India is to embark on any large campaign for fighting malaria, we are convinced that it will be first necessary to reduce considerably the price of quinine within India, and this can only be effected if India is self-supporting in production. To achieve this self-sufficiency a considerable extension to the present area under cinchona will be required. . . . We are satisfied that, in view of the great importance of extending cinchona cultivation and cheapening quinine, much more scientific investigation is called for than has been undertaken in the past."

Dr. Cowan has done well in summarising the present position and in pointing out the great importance to a large section of the human race of the development of quinine production.

Obituary.

Sir Archdall Reid, K.B.E.

SIR ARCHDALL REID, whose writings on heredity aroused considerable interest among the medical and general public between 1900 and the outbreak of the War, died suddenly on Nov. 18, at Southsea, at sixty-nine years of age.

Sir Archdall Reid was born at Roorki, N.W. Provinces, India, on April 7, 1860, and was the only son of Capt. C. A. Reid of the 20th Bengal Native Infantry, and therefore originally in the service of the Hon. East India Co. He was in his earlier years educated privately, and then studied medicine in the University of Edinburgh, where he took the degree of M.B. For some years after that he led a roving and adventurous life in India, New Zealand, the Pacific, and America, before settling down to general practice at Southsea. He there devoted most of the hard-earned leisure which his professional work left him to the study of heredity, and published several volumes of considerable length on the subject, as well as articles and communications to NATURE. The books are: "The Present Evolution of Man", 1896; "Alcoholism, a Study in Heredity", 1901; "Principles of Heredity", 1905; and "Laws of Heredity", 1910. These writings show that their author possessed an active, independent, and original mind and much ingenuity, but unfortunately the want of a first-hand practical and experimental knowledge in biology prevented him from fully appreciating the technical points of his subject. His point of view was that of the medical man, and he based his arguments chiefly on his knowledge of human disease and immunity.

Sir Archdall's general views of heredity and evolution were adopted from Weismann. He assumed that the differences between organisms were in general adaptive, and that evolution was due to natural selection acting on spontaneous variations, the effects of external stimuli never being inherited. He relied too much on verbal subtleties, which when carefully examined only put what was described before in other words; for example, his distinction between characters developed under the stimulus of nutrition, and those developed under the stimuli of use and injury, which comes ultimately to the same thing as inherited characters and acquired characters. He waged hopeless warfare against the facts and conclusions of Mendelism, which were then arousing enthusiasm among many biologists. One of his attempts to explain away the importance of the Mendelian results was obviously unreasonable. Mendelism was just beginning to consider whether the differentiation of sex was not a Mendelian segregation, when Sir Archdall maintained that "Mendelian inheritance is a human creation, and the right interpretation appears to be that nature treats mutations, when man interferes and presents them to her, as sexual characters". The excuse for this is of course that the genetics of sex and the relation of sex-limited characters to hormones were not then understood as they are now.

Many biologists, however, who reject the possibility of the effects of external conditions being inherited, would probably accept Sir Archdall's facts and conclusions concerning alcoholism and disease as perfectly sound. His view was that "susceptibility to the charm of alcohol" was an innate character and tends as such to be inherited in the same sense as the shape of a person's head; that, as in all innate characters, variation occurs in the tendency to intemperance in drinking alcohol, so that all degrees of it may be said to occur in any population. As in other cases, these variations are subject to natural selection, which means in this case that the worst drunkards are killed off or leave fewer children. The consequence is that peoples which have been exposed to the temptations of alcohol for the longest time are the most naturally temperate, while peoples who have had little or no experience of alcohol, when it is first introduced among them, drink without restraint. This, according to Sir Archdall Reid, is the explanation of the facts that in southern Europe, where the vine has been cultivated from early times, the people are temperate, and that northern peoples, such as Russians, Germans, and English, are more given to drunkenness. Similar arguments and conclusions were maintained by Sir Archdall with much ability and command of language with regard to resistance to disease. "Every race", he wrote, "is resistant to lethal disease in proportion to its past experience of it, but the resisting power is such that it can only have been evolved through Natural Selection."

Throughout the War, Sir Archdall served as medical officer and was made a K.B.E. in 1919.

J. T. CUNNINGHAM.

News and Views.

IT is with widespread regret that the news has been received of the destruction of the non-magnetic research vessel *Carnegie*, and the lamentable death of Capt. J. P. Ault, captain of the vessel, physicist, mathematician, and leader of the expedition, whose magnetic surveys extending over all the oceans since 1909 are known throughout the maritime world. The vessel, a brigantine belonging to the Carnegie Institution of Washington, was refitted last year and equipped for oceanographic and meteorological work as well as for the magnetic survey, and was fitted with an auxiliary bronze petrol motor. She had since completed half of the projected cruise of 110,000 miles when, on Nov. 30, refilling petrol in Apia Harbour, Samoa, an explosion occurred resulting in her total destruction. No other member of the scientific staff of eight received serious injury, from the reports yet seen. The Carnegie Institution has furnished classic material relating to the magnetic variation, dip and ocean meteorology, from the previous expeditions of this vessel and her predecessor under the leadership of Capt. Ault. During this cruise, data have also been obtained of the electric condition of the atmosphere at different levels, of wind velocities by means of pilot balloons, of atmospheric refraction, the intensity of solar radiation, temperature and humidity lapse rates above the sea. In addition, much oceanographic data have been collected, numerous stations having been worked from top to bottom for temperature and salinity of the water, which will add to our present knowledge of the hydrodynamics of ocean currents in the North Atlantic and Pacific. The nutrient salts, phosphates, and nitrates, necessary for and usually limiting plant life in the sea, have been studied, and the amount of minute plants and animals —plankton—estimated by means of hauls with fine-meshed nets. The work was being closely followed by the Admiralties, meteorologists, and marine biologists of many nations.

REFERENCE was made in NATURE of Nov. 23, p. 814, to the press announcements of the award of the Nobel prize for physics for 1929 to the Duc de Broglie for his work on the undulatory theory of matter. This work was carried out by M. Louis de Broglie, a younger brother of the Duc de Broglie, and it appears that the award has been made to the former. Maurice François César, Duc de Broglie, it will be remembered, is himself a distinguished physicist who received the Hughes Medal of the Royal Society last year for his pioneer researches on X-ray spectra and secondary β-rays. Reverting to M. Louis de Broglie, it may be added that it was his work which led Schrödinger to his well-known equation which is the basis of attack of problems by wave mechanics. The first experimental verification that an electron behaves like a wave was made by Davisson, and Germer, who studied the scattering of electrons from a single crystal of nickel. They were working at the Bell Telephone Laboratories, Inc., New York, and reported their experiments in a letter which appeared in NATURE of April 16, 1927, p. 558; a more detailed statement appeared in the *Physical Review* for December 1927. The experiments of Prof. G. P. Thomson and others on the subject were somewhat later, and different methods were adopted.

DR. A. B. RENDLE, who retires from the post of Keeper of the Department of Botany in the British Museum in January next, was educated at St. Olave's Grammar School and St. John's College, Cambridge, and entered the Museum in 1888. By this time the collections which had been transferred from Bloomsbury in 1880 had been arranged, but there was still much to do, and Dr. Rendle then and there began his interest in the public gallery and index museum, the exhibits in which have been mainly his work. His systematic studies deal mainly with Monocotyledons, Apetalæ, and Gymnosperms, on which he has published more or less continuously for the past forty years; but he has also done critical work in other groups, for example, Convolvulaceæ and Urticaceæ. He was appointed keeper in 1906 in succession to G. R. M. Murray, who retired through ill-health before he was fifty. During Dr. Rendle's tenure of office the Department has probably doubled in size in every way. He was elected a fellow of the Royal Society in 1909.

THE keepership of a natural history department usually carries with it a number of non-official obligations, and Dr. Rendle has taken a pleasure in entering into these to the full. Amongst other activities, after serving on the Council of the Linnean Society, he became botanical secretary from 1916 until 1923, and president from 1923 until 1927. During this last period, the Society was undergoing certain changes which might have made for difficulties with a less experienced president. For the period 1894–1906, Dr. Rendle was head of the Botanical Department at Birkbeck College, and has always taken an interest in the teaching of botany, academic and otherwise. He has been president of several societies—South-Eastern Union of Scientific Societies, South London Botanical Institute (almost from its start), Quekett Microscopical Club—and has been honorary professor of botany to the Royal Horticultural Society for some years. After J. Britten's death in 1924, he added to his many duties that of editor of the *Journal of Botany*. His principal works are "The Classification of Flowering Plants", of which Vol. 1 appeared in 1904 and Vol. 2 in 1925, and the "Flora of Jamaica", with the late W. Fawcett; this latter began in 1910, and it is to be hoped that Dr. Rendle will be able to complete it. After his long reign as keeper he will doubtless appreciate the botanical opportunities which a well-earned retirement brings.

MR. J. RAMSBOTTOM, deputy keeper of the department of botany since Nov. 1927, who succeeds Dr. A. B. Rendle as Keeper, entered the Department in 1910, after studying at Cambridge and Manchester. He was appointed to the section on fungi, which previously had not received the attention due to its importance. During the first part of the War, many

investigations were carried on in the Department, and later Mr. Ramsbottom was seconded to the War Office for service as protozoologist in Macedonia. His civilian days came to an end after about a year's service, and he was attached to the R.A.M.C.; he was mentioned three times in despatches and awarded the M.B.E. and O.B.E. The cryptogamic herbarium at the Museum has become more and more important since the War, and is likely to continue. Mr. Ramsbottom was president in 1924 and is general secretary of the British Mycological Society; he has been botanical secretary of the Linnean Society since 1923, and this year he is president of the Quekett Microscopical Club.

THE second of three windows placed in St. Ethelburga's Church, Bishopsgate, to the memory of the seventeenth-century navigator, Henry Hudson, was unveiled on Nov. 28 by Mr. A. Halsted, the American Consul-General in London. This window, like the first, is the gift of certain citizens of the United States. In it Hudson is shown exploring the Hudson River in the *Half Moon*, finding Red Indians welcoming his approach. His first voyage was made for a company of London merchants, and it was in St. Ethelburga's that Hudson and his crew made their communion on April 19, 1607, before going aboard. Nothing is known of him prior to that, but in the course of the succeeding years he made four voyages, first to Greenland and Spitsbergen, then to the coast of Novaya Zemlya, thirdly to the Atlantic coast of America, during which he explored the Hudson River a little farther than Albany, and lastly to Hudson Bay. He was not the discoverer of either the river, the straits, or the bay which bear his name, but he added much to the geography of North America. Preparing to return to England in the spring of 1611, a part of his crew mutinied, and Hudson with his son and seven others were turned adrift in an open boat, after which nothing more was heard of them. Like many other voyages, Hudson's were undertaken with the view of finding a northern passage to the East Indies.

DURING the recent meeting of the International Institute of African Languages and Culture, held in London, the members were entertained by the Government at a luncheon given at the Hotel Cecil on Nov. 28, when a large number of distinguished guests was present. The occasion was made notable by a speech from Lord Passfield, in which he paid a tribute to the value of anthropology in the administration of the affairs of a backward people. Every young man, he said, who goes out to take part in administrative work ought to receive very definite training in anthropology, and he went on to express the hope that the beginning which has been made in giving training of that kind may be increased and intensified. A pronouncement of so emphatic a character, coming from the head of the department in charge of the Dependencies in which the officers to whom he referred will have to carry on their work, cannot fail to stimulate the study of native institutions and intensify the interest taken in them by those who are preparing to enter the Colonial services.

IT may not be inapposite to point out, however, that facilities for training probationers for the Colonial services have long been provided by universities and other educational institutions of Great Britain, which have repeatedly urged upon those in authority the desirability and, indeed, the necessity that administrative officers should receive a grounding in anthropology before taking up their duties. Prof. Westermann, a director of the Institute, in thanking Lord Passfield for his encouraging speech, pointed out the utility of such an organisation as the Institute to traders, planters, settlers, administrators, educationists, and missionaries in helping them to the solution of the problems with which they are surrounded. It is unfortunately only too true that while, as Prof. Westermann pointed out, the vital interest in Africa is the African, the whole aspect of his life is threatened by the white man's activity. It cannot be too widely realised that only a sympathetic and well-informed administration, with a policy based on a study of native custom, can solve the problems upon which depend the whole political and economic future of Africa.

COMMANDER R. E. BYRD on Friday of last week made a successful flight from the Bay of Whales on the Ross Barrier to the South Pole and back. He returned in the early hours of Saturday morning, having accomplished the distance of about fifteen hundred miles without mishap. On the return journey, a descent was made for refuelling at a depot of petrol which had been placed on the Barrier 400 miles south of his base. Details of the flight and Commander Byrd's discoveries are still lacking, but his course, if straight, must have been approximately that of Captain Amundsen in his sledge journey in 1911. In order to cross the lofty Queen Maud Ranges, Commander Byrd must have risen to more than 10,000 ft. At that altitude, if the weather was clear, he should have seen the unknown eastern edge of the Barrier, hinted at by Amundsen, and also the course of the Queen Maud Ranges to the south-east. Sir Hubert Wilkins is also in the Antarctic at his base at Deception Island, South Shetlands, where he is preparing for his contemplated flight westward along the Pacific edge of the Antarctic continent to the Ross Barrier.

WHILE it may be one thing to have proved an oilfield to be worth working from a commercial point of view, it may be quite another matter to exploit it successfully if questions of title to concessions, exploration and development rights, royalties, refining practice, employment of nationals, and so on, founded on insecure legal codes, are constantly raised at the slightest whim of governments. Such matters of higher policy, particularly in the case of companies operating in foreign territories, call for administrative ability of no mean order, and few, even within the oil industry, appreciate the extent of the diplomatic workings necessary, both at home and abroad, to secure uninterrupted operations. Instance the country inexperienced in oil production suddenly finding itself the possessor of newly discovered petroleum resources; in the general scramble for titles, probably exaggerated

optimism, and public dreams of quickly gotten wealth, a number of laws, loose in construction, impossible of rational interpretation, are passed; as time goes on and developments promise well, various conditions and petty restrictions are imposed, either with the view of diverting more money into the national exchequer, or of giving the government (more probably its favoured officials) active participation in the affairs of the company.

A KIND of communal possessive instinct is manifest, strengthened in proportion as the industry grows; the attitude of disinterested complacency at the pioneer stage, while the oil company was spending money and earning none, rapidly changes to one of mere tolerance and desire to profit the moment success is assured; the public is urged to protect its rightful interests; the cry of nationalisation of internal resources is raised, and everything done to make conditions as difficult as possible for the harassed company officials. Usually, the proportion of local staff employed is compulsorily raised until the company finds itself flooded out with superfluous, inefficient labour; then long and protracted negotiations are undertaken between government and executive to find a policy which will placate the former and yet make it possible for operations to continue on a paying scale. These are among some of the more complex problems propounded by immature oil legislation, and Sir Arnold Wilson was right when he stated in a paper read before the Institution of Petroleum Technologists on Nov. 12 that unsuitable laws retard, and good laws encourage, developments of the oil industry, especially in countries such as Central and South America, where the evils of defective law and inconsistent legislation have often had to be reckoned with by the concession hunter or lease-holder.

THE compound for which the handy abbreviation of 'S.U.P. 36' has fortunately been adopted, is the symmetrical urea of para-benzoyl-para-amino-benzoyl-amino-naphthol 3 : 6 sodium sulphonate; it was introduced by McDonagh, in the belief that it would prove of value in therapeutics by stimulating the tissues of the host to overcome various acute microbial infections. R. M. Pearce (*Brit. Med. Jour.*, Oct. 12, pp. 663 and 831; 1929) has recently described its use in influenza: in a series of more than eighty cases, every alternate patient was given 0·005 gm. S.U.P. 36 intramuscularly when the onset had occurred within the preceding forty-eight hours, and a further dose of 0·0075 gm. if necessary on the fourth day. The uninjected cases served as controls. It was found that the duration of the pyrexia, of the headache and muscular pain, as well as the total duration of the illness, were about halved by the injection of S.U.P. 36. J. S. Hall (*ibid.*, p. 831; 1929) has also found it of value, in doses up to 0·01 gm., in a variety of conditions, including the severe vomiting of pregnancy, acute pyelitis, cystitis and mastoiditis, osteomyelitis and broncho-pneumonia in children. The compound, however, does not act as a preventive if injected when no acute infection is present. Further details of its action and uses are given in a little brochure published by The British Drug Houses, Ltd., Graham St., London, N.1, who prepare the compound, manufactured by British Dyestuffs Corporation, Ltd., for medical use: it is issued ready for intramuscular injection in isotonic solution in ampoules or rubber-capped vaccine bottles.

THE maximum power which may be radiated by broadcasting stations was limited to a hundred kilowatts by the International Consultative Committee at the Hague Conference. An unfortunate consequence of this decision is that this enormous power is regarded by many as the standard which should be aimed at when constructing a national broadcasting station. Some of the European States which are now constructing broadcasting stations are proposing to use very high powers, notwithstanding that the use of crystal receivers is now dying out, and that the number of listeners using valve sets is rapidly increasing. So far as reception in Britain is concerned, there is little interference at present by foreign transmissions, but in the immediate future when more giant stations are constructed abroad trouble due to this cause will be serious.

IN the early days of broadcasting, both in Great Britain and abroad, the stations provided about one kilowatt to the aerial. According to the *Wireless World* for Nov. 27, Germany was the first country to increase the power of its stations. As other countries began to build transmitters the natural tendency was to equal or raise the four kilowatt standard set by Germany. Five and ten kilowatt broadcasting stations became quite common. Germany is now considering a scheme for installing new high-power stations in addition to the present transmitters, and proposes to combine them into groups. The lower-power transmitters will operate on the national wave-length in conjunction with a high-power station. If this scheme is adopted, the German transmitters will once more dominate Europe, and other States will be stimulated to follow the German example. As a rule, the higher the power of a station the more costly is its construction. It will be very difficult, therefore, to modify European broadcasting in the future should this become necessary, owing to an excessive number of high-powered stations.

DURING last year immense strides were made in the development of broadcasting in Japan. Six modern broadcasting stations have been opened, with the idea of bringing as many listeners as possible within crystal range of some station. The new stations are each rated at 10 kilowatts, and are housed in new buildings so as to leave the original transmitters still available in case of emergency. All call signs in Japan are given out in English, and consist of four letters commencing with J.O. and ending with K. For example, J.O.A.K. stands for Tokyo, and J.O.C.K. for Nagoya. The entire broadcast wave-length lies between 350 and 400 metres. We learn from *Electrical Communication* for October that the equipment of all the stations has been imported from England. Sendai (J.O.H.K., 389·6 m.) is the chief town in the north of the main island. It is here that Prof. Honda's laboratory for metallurgical research is situated.

Every physicist and electrician knows the important work that he has done in connexion with cobalt magnet steel, now known as 'K.S. steel', work that has proved a great boon to the designers of electrical apparatus. For listeners outside Japan this station is the most favourably situated. New Zealand has reported excellent reception. Owing, however, to the mountainous nature of the country, the signal strength from any station varies considerably with its locality. There are one or two large cities situated quite close to a broadcasting station where reception is sometimes very poor. It is probable, therefore, that it will be found advisable to supplement the present main stations by small relay stations of two kilowatt capacity, when the demand gets greater.

THE study of the habits and psychology of the great apes must always be of supreme interest for their human relatives. Such study in the Old World has been provided for by the French station at Kindia, in Africa, where the apes can be observed in conditions approaching those of their natural life and in a favourable climate. According to a *Daily News Bulletin* issued by Science Service, Washington, D.C., a similar station, in which natural conditions will be copied so far as possible, is to be created on a 200-acre plot near Orange Park, Florida, under the auspices of Yale University. This great scientific ape-breeding farm has been made possible by a gift of 500,000 dollars from the Rockefeller Foundation.

UNDER the Boiler Explosion Acts of 1882 and 1890, the Board of Trade is authorised to hold inquiries into explosions of steam boilers and steam apparatus in Great Britain, and 62 such inquiries were held during 1928. Some of the accidents resulted in injuries to persons, of whom seven died, and also in great financial loss. The explosions included accidents to marine and land boilers, steam pipes and valves, bakers' steam-heated ovens, economisers, drying cylinders, etc. At the beginning of the present year, during the severe frost in February, many explosions of heating apparatus took place, and those which occurred in churches, schools, and other institutions were the subject of inquiry. In every case it was shown that ice forming in the pipes had choked the system and that the safety arrangements had become inoperative. Explosions in private houses were reported in the Press at the time, and it is probable there were a large number of such failures. With the approach of winter, it cannot be too strongly impressed upon all who have charge of steam and hot-water heating systems that the safety valves or safety discs should be placed on the boilers themselves and not in the heating pipes at some distance away. Practically every accident to heating apparatus which has come to our notice would have been prevented had the safety appliances been so placed.

AT a recent meeting of the New York Electrical Society, Mr. E. W. Stearns gave some particulars of the great suspension bridge now being built over the Hudson River, which will connect New York City and New Jersey. The bridge will be ready for use in 1932, and when completed will be by far the largest suspension bridge in the world, having a span between the towers of 3500 feet. The two towers, each 635 feet high, will carry a weight in cables alone of 28,000 tons, the cables containing more steel wire than the next seven largest suspension bridges combined, the Brooklyn, Williamsburgh, Manhattan, Detroit, Philadelphia, Bear Mountain, and Poughkeepsie bridges. Made of steel wire with a tensile strength of 230,000 pounds per sq. in., each of the four main cables will contain 26,474 wires made up of 61 strands of 434 wires each. To squeeze the cables into circular shape a squeezing jack with hydraulic cylinders will be placed around the cable and this will bring a pressure of 400 tons to bear on the cable. Sufficient elasticity is incorporated into the design of the towers and the bridge to allow of a sag of ten feet, but the sag under normal loading will not be more than four feet.

THE twelfth of the series of the Rockefeller Foundation, New York, devoted to "Methods and Problems of Medical Education", is given up to articles by specialists in charge of "Departments and Institutes of Röntgenology and Radium Therapy". This is a very valuable compilation, and it appears opportunely when big movements are afoot for the development of radiology in medicine. The book is essentially a presentation of how this subject is dealt with the world over; the various departments and organisations are described in detail with lists of personnel and occasionally estimates of cost of running such departments. Such a publication has a twofold value. In the first place, the reader can gather the extent to which radiological methods are at present used in everyday diagnosis and treatment of patients; and in the second place, those who are concerned with the initiation or development of departments of this kind will have at their command a mass of information which should be of the greatest scientific and economic service to them.

AN account of the modern methods of fishery research as undertaken by the biological laboratories and fisheries institutes on the coast of the North Sea and Baltic is given in Lief. 12, Teil $1.e_1$ (Fischereibiologie by W. Schnakenbeck) of Grimpe and Wagler's "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928). After an introduction and brief historical survey, the author proceeds to describe the various nets, dredges and trawls in use for both fishes and invertebrates, including plankton nets and water bottles for the smallest organisms, and, for sampling the bottom, the 'grab'. The most important methods of research are then briefly noted, particularly age-determination and the marking of fishes, and the study of animal communities at the bottom in connexion with fish food, besides method of plankton research. There are good illustrations of the research vessels employed by the laboratories and institutes in Heligoland, Denmark, Sweden, Norway, Scotland, and England, also of the nets, dredges, water bottles, and grab, figures showing representative bottom communities and numerous maps and diagrams. The whole forms a useful introduction to methods of fisheries research.

THE Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers will be delivered on Jan. 3 at 6 P.M. by Eng. Vice-Admiral R. W. Skelton, who will take as his subject "Progress in Marine Engineering".

LORD BLEDISLOE, president in 1922 of Section M (Agriculture) of the British Association and Parliamentary Secretary to the Ministry of Agriculture from 1924 until 1928, who has for many years identified himself with agricultural interests, has been appointed Governor-General of New Zealand in succession to General Sir Charles Fergusson, whose term of office expires early next year.

PROF. G. ELLIOT SMITH will deliver a lecture on Java in the Great Hall of University College, Gower Street, W.C.1, on Monday, Dec. 9, at 5.30 p.m. Prof. Elliot Smith visited Java last summer when, acting as one of two representatives of the British Government, he attended the Pacific Science Congress held at Batavia in May last. The lavish hospitality of his hosts gave Prof. Elliot Smith every opportunity of seeing whatever was worth seeing in their colony. He visited the principal sites of archæological interest, saw something of life in the native protectorates, including the courts of the sultans, and also visited the island of Bali, interesting from the peculiar nature of its people, its culture, and its religious ceremonial. Prof. Elliot Smith's lecture will cover an attractive and, to the average Englishman, little-known field.

THE first S. M. Gluckstein Memorial Lecture of the Institute of Chemistry will be delivered by Dr. Leslie H. Lampitt at the Institute on Friday, Dec. 13, at 8 P.M. Dr. Lampitt has chosen for his subject "The Chemist and Commerce". The late S. M. Gluckstein, a director of Messrs. J. Lyons and Co., Ltd., read before the London and South-Eastern Counties Section in October 1927 a paper entitled "Chemistry and Dividends", in which he gave an account of the development of the chemical staff and laboratories of his company, illustrating the bearing of science, and particularly chemistry, on the management of a large industrial undertaking. The laboratory staff of the company is now 72 chemists and assistants, who are accommodated in the laboratories at Kensington, opened this year, of which Mr. Gluckstein, who died on Aug. 29, 1928, did not live to see the completion. In memory of the Director who had taken so great an interest in their work, the staff of the laboratory, of which Dr. Lampitt is the head, offered the Council of the Institute a sum of approximately £200 to administer this fund for the provision of an annual lecture, the purpose of which is to show the bearing of science on industry, particularly in various fields of chemical activity. The lecture will be open to members of other societies and to the public.

WE have received vol. 6 (1928) of the *Transactions of the Institution of Chemical Engineers*. This contains the presidential address of Sir Alexander Gibb on the economics of power as applied to chemical engineering, papers on magnetic separation, the combustion of powdered coal, treatment of beet sugar factory effluents, fluid jets, electrodeposition of rubber, and several papers on drying.

FOR the hundred and tenth annual meeting in Davos of Schweizerische Naturforschende Gesellschaft a 'Festschrift' of some twenty articles was produced (B. Schwabe and Co., Basel). All the articles have a bearing on Davos and they are of a varied nature. Several are meteorological, one of them dealing with the intensity of the insolation. Others treat of the geology, flora, birds, and butterflies of the district. Two articles are descriptive of the research institutions of Davos and five treat of medical subjects germane to the district. The volume has a number of photographic illustrations.

THE International Baltic Geodetic Commission held its fourth session at Berlin in September last year. All the States adjoining the Baltic except Russia were represented. The proceedings are now published in *Verhandlungen der Baltischen Geodätischen Kommission* (Helsinki, 1929). The daily proceedings are recorded, and several of the more important papers are printed at length with maps. All of the States concerned provided papers on some aspect of their geodetic work, and several States, notably Denmark, contributed accounts with charts of the present state of triangulation. The next meeting of the Commission is to be in Copenhagen in 1930.

THE Department of Agriculture and Stock of Queensland has recently published a useful manual entitled "Pests and Diseases of Queensland Fruits and Vegetables", by Messrs R. Veitch and J. H. Simmons. This handbook supplies the want for a trustworthy account of the commoner pests of Queensland fruits and vegetables and, at the same time, provides a short introduction to the elements of entomology and plant pathology. It can be recommended as a good practical account of the subject and its value is much enhanced by sixty-one excellent plates, both black-and-white and coloured, which have been executed in Australia. The book bears the name of the Government Printer, Brisbane, 1929, but no price is stated.

THE International Society of Experimental Phonetics has arranged for the following official organs to be sent to its members at reduced prices: *Zeitschrift für Experimentalphonetik*, quarterly, 5*s*. (instead of 10*s*.); *Comptes rendus de la Société Internationale de Phonétique expérimentale*, annually, no charge; *Bulletin of the International Society of Experimental Phonetics*, annually, 1*s*.; *Sprachneurologische Mitteilungen*, quarterly, 4*s*. (instead of 6*s*.); *Archives Neérlandaises de Phonétique expérimentale*, annually, 6*s*. 7*d*. or 4*fl*. (instead of 5*fl*.); *Archiv für Psychiatrie u. Nervenkrankheiten*, 20 per cent reduction. All persons—as well as libraries, institutes, corporations, business firms, etc.—who are interested in experimental phonetics may become members of the Society. Only experimental phoneticians of acknowledged standing may be members of the council. Applications for membership, accompanied by the fee

of 10s., may be sent to the president, Prof. E. W. Scripture, 25 Howard Road, Coulsdon, Surrey, England.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 172 of upwards of 2000 second-hand books of science classified under the headings of horticulture, plant collecting, herbals, and general botany; local floras; geology, mining, palæontology, etc.; ornithology; general natural history, including entomology, mammalia, fishes, invertebrata, mollusca, etc.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in engineering at the Kenrick Technical College, West Bromwich—The Director of Education, Education Offices, West Bromwich (Dec. 14). A chemical laboratory assistant at the Royal Arsenal, Woolwich—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18 (Dec. 14). Temporary inspectors under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh (Dec. 14). A part-time lecturer in mathematics at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (Dec. 16). A Paterson research scholar in the Cardiographic Department of the London Hospital—The House Governor, London Hospital, E.1 (Dec. 17). A guide-lecturer and professional assistant at the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (Dec. 21). An investigator at the Royal Aircraft Establishment for research work in connexion with the electro-deposition of metals—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 388) (Dec. 21). A permanent inspector under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh (Dec. 21). Two assistant entomologists under the Division of Economic Entomology of the Commonwealth Council for Scientific and Industrial Research, for work on the Buffalo Fly Problem—F. L. McDougall, Australia House, Strand, W.C.2 (Dec. 30). A principal of the Central School of Arts and Crafts, Southampton Row, W.C.1—The Education Officer (T.1), County Hall, Westminster Bridge, S.E.1 (Jan. 20). A resident research fellow at Lady Margaret Hall, Oxford—The Hall Secretary, Lady Margaret Hall, Oxford. A lecturer in geography at St. Mary's College, Strawberry Hill—The Principal, St. Mary's College, Strawberry Hill, Middlesex. A chief lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. An evening lecturer in refrigeration at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A temporary junior assistant for a Government Laboratory—Z. E., c/o Charles Barker and Sons, Ltd., 31 Budge Row, E.C.4.

Our Astronomical Column.

Solar Activity.—The temporary revival of solar activity shown during the last few weeks has been continued by the recent appearance of two other large groups of spots. One of these was a big regular spot of about 1000 millionths of the sun's hemisphere, and was therefore a conspicuous naked-eye object. This spot was the return of a complex stream, No. 13 in the list given in NATURE, Nov. 9, p. 737. The other group (No. 15) represented a new outbreak in the place of No. 12. The following table is continued from the note in our issue of Nov. 9 :

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
15	Nov. 21–Dec. 4	Nov. 27·9	13° N.	900
16	Nov. 24–Dec. 6	Nov. 30·3	16° N.	1000

Spectrohelioscope at Greenwich.—A spectrohelioscope is being installed at the Royal Observatory, Greenwich. The instrument, which has been lent by the Mt. Wilson Observatory, is one of several constructed according to Dr. G. E. Hale's design in the observatory workshops at Pasadena. A description of this ingenious adaptation of the spectroscope, and the observations it is possible to make with it, will be found in various contributions made to NATURE by Dr. Hale during the past few years (see July 3, Supplement, 1926; May 14, 1927, p. 708; April 28, 1928, p. 676).

Jupiter.—Fourteen months ago Rev. T. E. R. Phillips announced the appearance of a series of small spots in the southern hemisphere of Jupiter which had such a high westward velocity that their apparent period of rotation was $9^h\ 59^m$, the highest value on record. In *Circular* No. 79 of the British Astronomical Association, he describes some recent observations made by Mr. A. Stanley Williams at St. Mawes, Cornwall. They refer to some spots on the south edge of the North Temperate belt, which have the abnormally short rotation period of $9^h\ 48^m\ 49^s$, indicating a rapid eastward motion on the planet's surface. There is, therefore, a difference of more than 10^m between the rotation periods of the spots of 1928 and the present spots. It is further noted that spots in the same latitude as the present ones were seen in 1880, 1891, 1892. These also gave an unusually short period of rotation.

Stellar Spectroscopy at Dominion Observatory, Victoria.—The *Publications* of the Dominion Observatory, vol. 4, Nos. 12 and 13, contain two interesting researches on spectroscopic binaries. No. 12, by R. N. van Arnam, treats of the star β Cephei, which is of mag. 3·3, type *B*1. The period is 0·1904843 day. Treating the change in radial velocity as due to orbital motion, the orbit elements appear to have changed notably between 1919 and 1922. The semi-amplitude of the velocity range changed from 13·1 to 9·5 km./sec., the difference being eight times the probable error; $a \sin i$ changed from 34,043 km. to 24,606 km. The symmetry of the velocity curve indicates that if the change in radial velocity arises from orbital motion the orbit is appreciably circular.

No. 13, by W. E. Harper, describes the orbits of two spectroscopic binaries of unusually high eccentricity. Boss 4177, mag. 5·72, type *A*o, has a period of 4·951 days and eccentricity 0·511; the semi-amplitude of the velocity range is 16·28 km./sec.; only one spectrum is visible. H.R. 7338, mag. 6·19, type *A*o, shows the secondary spectrum faintly; the minimum mass of the system is twice that of the sun, divided in the ratio 1·180 to 0·844; the period is 10·3932 days, and the eccentricity 0·520.

Research Items.

Anthropology and Blood-Groups.—In *Man* for November, Dr. H. Woollard and Dr. J. B. Cleland discuss the evidential value of the blood-groups in anthropology as an indication of race. Their view differs fundamentally from that now generally held, and is primarily based upon investigation of the blood-group in the Australian aboriginal. It has been observed that the *A* group is the most frequent in the aborigines who belong to Central and South Australia, and when the results are those of natives whose purity is above suspicion, it is found that the Australian aboriginal contains no *B* factor. On this evidence it has been suggested that the Australian has Nordic affinities, while other investigators, finding the evident discrepancies in the group percentages of closely related peoples, have been tempted to ignore blood-groupings. Obviously percentage grouping is only one racial character which no more suffices to distinguish race than any other single character. Taking the evidence afforded by the blood-grouping of the anthropoids, the American Indian, and the Australian, it is here suggested, contrary to the view hitherto put forward, that the original human family contained all four groups. Instead, then, of this single anthropological character being expected to stamp each variety of man, the problem is rather to explain how the existing varieties of man obtained their present percentage, and indeed how a human type escaped an inheritance of all four groups and comes to possess one only. Thus the high frequency of the *A* factor in the Australian aboriginal implies no close affinity with Nordic man, who also possesses a high percentage of the *A* factor. The constitution of a grouping such as that in the Australian would force the assumption that their ancestors started with this genetic constitution, that they were few in number, and that they have lived for a long period in isolation.

Vaccination against Anthrax.—In the current number (Vol. 62, Parts 6-10) of the *Rendiconti* of the Royal Lombardy Institute of Sciences and Letters, Dr. Mario Mazzucchi describes the results of experiments on a new method of vaccination against anthrax. The procedure followed differs fundamentally from that used by Pasteur, as it employs, not attenuated anthrax bacilli, but virulent germs and spores. Only a single injection is made, and twelve days later immunity from the disease is so complete that the treated animal is able to withstand an injection of anthrax organisms sufficient to produce fatal results in control animals within 40-60 hours. The tests were made at both the Istituto Sieroterapico of Milan and the Stazione Sperimentale di Zooprofilassi in Rome, and were carried out on goats, sheep, and cows, always with the same result—that the new vaccine is far more efficacious than the three Pasteur vaccines with which it was compared. The observations made by Dr. Mazzucchi indicate that it is necessary in experimental work of this kind to bear in mind that the resistance of an animal to anthrax may be of any of the following forms: (1) Individual resistance, common to all animals, no matter what the species; (2) regional resistance, which appears to be the greater with animals accustomed to the wild state; (3) resistance from natural acquired immunity, not infrequent in animals which live in infected zones and may have contracted infection and undergone spontaneous cure; (4) a complex immunity consisting of type (3), reinforced by the slight action of an attenuated vaccine.

Tidal Zone Fauna in Sand and Mud.—Mr. A. C. Stephen, in his "Studies on the Scottish Marine Fauna: the Fauna of the Sandy and Muddy Areas of the Tidal Zone" (*Trans. R. Soc. Edinburgh*, vol. 56, Pt. 2, No. 14, 1929), continues his examination of the fauna of the intertidal bays which was begun in the Island of Cumbrae in 1926 and is now extended to various other areas on the Ayrshire coast, Firth of Clyde, south coast of Moray Firth, Aberdeenshire coast, St. Andrews Bay, and the Firth of Forth. Mollusks and polychætes are specially dealt with, only a few species being common and widely distributed: such are *Tellina tenuis*, *Nephthys cœca*, *Donax vittatus*, *Cardium edule*, and *Macoma baltica*. The two first are characteristic of clean sand, and, locally, also *Donax vittatus*, the two last living on muddy ground or black and strong smelling sand. In certain areas the two types intermingle, the nature of the soil evidently being an important factor when dealing with distribution. Each species has a region of maximum concentration. *Tellina tenuis* is almost always most abundant at low-water mark, gradually decreasing towards high-water mark, *Macoma baltica* and *Cardium edule* having their maxima between tide-marks. A further research into the food of these invertebrates would be of great value, and it is to be hoped that this will be forthcoming.

Influence of Light on Larval Ascidians.—Experiments with larvæ of *Symplegma viride* were made last year at the Tortugas Laboratory by Mr. Caswell Grave. This year a note by the same author (*Year Book* No. 27 of the Carnegie Institution of Washington, 1928) shows the response to light stimuli by *Polyandrocarpa tincta*, a species closely related to *Symplegma*. The small larva is liberated in large numbers and its free-swimming period is relatively long (transforming in the course of a day under laboratory conditions). Experimentally, the majority of the larvæ can be induced to metamorphose and attach themselves in about 70 minutes by subjecting them soon after being set free to alternate periods of light and darkness, a typical instance being 25 or 30 one-minute 'doses' of light, each followed by a one-minute 'dose' of shadow. The light was ordinary diffuse light from the laboratory windows, allowed to come only from the east, other sources of light being blocked, and the experimental vessels were covered by tumblers wrapped in black paper for the period of darkness. Controls exposed to the same light but without periods of darkness took several hours to metamorphose. The rhythmic alternation of the periods of light and darkness is of importance, intensity of light making little or no difference. The natural habit of the free-swimming larva is to swim up and down between the surface when it is light and the bottom when it is dark, until a "final stimulus to attachment and metamorphosis is released".

The Trematode Family Schistosomidæ.—This family is the subject of a useful and compact synopsis by E. W. Price (*Proc. U.S. Nat. Mus.*, vol. 75, Art. 18, 39 pp., 1929), who has carefully assembled the descriptions of the known genera and species, has prepared keys for aiding their identification, and clear illustrations to show their diagnostic characters. Three new genera are founded—*Heterobilharzia*, for some male worms from the mesenteric veins of the North American lynx; *Paraschistosomatium*, of which the female only is known from the portal vein of a bird from Texas; and *Microbilharzia*, from the mesenteric veins of North American birds.

Encystment in Rotifers.—David L. Bryce (*Jour. R. Micr. Soc.*, vol. 49, Pt. 3) records observations on

the encystment of three Bdelloid rotifers. He states that no evidence of encystment exists in rotifers other than Bdelloids, but suggests that it is widespread in this order, and is correlated with the habits. A large proportion, probably the great majority, of Bdelloids have alternate periods of activity and of dormant existence according as the moss in which they live is wet or dry. So long as the moss is wet they are active and multiply, but when the moss begins to dry they retract their extremities within the central portion of their bodies, reducing their bulk as much as possible, and pour out a secretion which completely covers them and hardens to an air-proof coating. When the moss is again wetted by dew or rain, the coating is dissolved and the rotifer renews its activity. The author refers to the flimsy character of the envelope, "that it would afford any protection against desiccation is not known". He suggests that the reason why similar examples of encystment have not previously been detected is perhaps that few observers have kept these rotifers alive from day to day in almost minute quantities of water. That the short supply of water was the reason for the encystment in these cases can scarcely be doubted.

Japanese Calcareous Sponges.—Only six species of calcareous sponges had been recorded from Japan until Prof. Sanji Hōsawa took up the study of this special group, and now he has added fifty-one more species from this region, no less than forty-seven of which are new to science. Some of these have already been described by the author (1916, 1918), who in a recent memoir, "Studies of the Calcareous Sponges of Japan" (*Journal of the Faculty of Science*, Imperial University of Tokyo, Section 4, Zoology, vol. 1, part 5, January 1929), revises what has been written by previous authors, and gives detailed descriptions of those forms which he has himself observed. The specimens were furnished by various collections from many localities, in depths ranging from shallow water to 572 metres. Thirty-four new species are described in this paper, and these are for the greater part preserved in the museum of the Zoological Institute of the Science Faculty in Tokyo. There are twelve plates with photographs of the individual sponges, and beautifully executed coloured figures showing sections with details of the skeleton, and there are in addition many text figures of the spicules. The new species include three *Leucosolenia*, one *Dendya*, one *Leucaltis*, one *Sycetta*, seven *Sycon*, one *Grantessa*, three *Vosmæropsis*, two *Grantia*, two *Ute*, and thirteen *Leucandra*.

Origin of Cultivated Dahlias.—In an interesting paper, Mr. W. J. C. Lawrence (*Jour. Genetics*, vol. 21, No. 2) has given an account of genetical and cytological work on dahlias. Mexico and Central America is the home of this genus. Three species are found to be tetraploid ($2n = 32$), while *D. Merckii* has 36 chromosomes and *D. variabilis*, the common dahlia, is confirmed as having 64 chromosomes, an octoploid number. It was figured so early as 1615, and was probably grown as a garden plant in Mexico long before its introduction into Europe. Considerable evidence is brought in favour of the view that this octoploid species arose as a cross between two tetraploids, the hybrid being sterile but later producing a fertile form with twice as many chromosomes. It is found, for example, that ten species fall into the ivory-magenta-purple colour series, while four others are ivory-yellow-scarlet, while *D. variabilis* alone has factors belonging to both series. The inheritance of the *Y* factor for yellow flavone is, moreover, tetrasomic, resulting from random assortment of four homologous chromosomes. In the reduction division, associations composed of two, four, six, and eight chromosomes can be seen, apparently resulting from the earlier conjugation of homologous chromosomes in synapsis. No more striking case could be found of the way in which correlated cytological and genetical investigations throw light on the origin and history of cultivated forms, and it is to be hoped that these researches will be carried further.

Bibliography of Genetics.—There has recently appeared a work which should prove of considerable value to plant breeders and others interested in the subject. This is the "Bibliographical Monograph on Plant Genetics, 1900–1925", by H. Matsuura, published by the Tokyo Imperial University—a large octavo volume of 500 pages. The greater part of the work gives a résumé of genetical researches under the heading of the various genera arranged in alphabetical order. The geneticist has only to look up the genus, and he will at once find a succinct account of what has been already done, with full references to the original papers in the bibliography which forms the second part of the work. There can be few students of the subject who have not frequently experienced the need of such a work, and they will be grateful to Mr. Matsuura for the immense labour that has gone into its compilation. It can be obtained in London from Messrs. Dulau and Co. of Bond Street, for the moderate price of 10*s*. 6*d*.

Non-Marine Mollusca of Oregon and Washington.—Unlike the marine, which have been closely studied, and the literature of which is obtainable in comparatively compact form, the non-marine mollusca of the States of Oregon and Washington have been relatively neglected and their literature dispersed in scattered papers. This has now been remedied by the publication of a monograph by Junius Henderson (*Univ. Colorado Studies*, vol. 17, No. 2). Considerable material for the purpose was obtained on expeditions sent out by the University of Colorado Museum, whilst the author himself visited personally 225 widely distributed localities in the two States. The contents of other collections and past records have also been drawn upon. As a result some 186 species are recorded and figured in text illustrations, every endeavour having been made to render the identifications and synonymy correct and to bring the nomenclature up-to-date. A useful index has been provided.

Bibliography of Seismology.—In the spring of 1926, the Eastern Section of the Seismological Society of America began the publication of a valuable bibliographical bulletin of works relating to earthquakes. The bulletin was issued quarterly under the editorship of Mr. E. A. Hodgson, and was distributed in a immeographed form to the members of the Eastern Section as well as to various scientific journals. It was afterwards reprinted in the *Bulletin* of the Seismological Society. It has now been decided to continue the previous lists in a new series entitled "Bibliography of Seismology", the first part of which (for Jan.-Mar. 1929) appears under the same editorship as before in the *Publications* of the Dominion Observatory, Ottawa. It contains the titles (with an occasional brief abstract) of one hundred papers.

Raman Effect.—The amount of light that is scattered by a fluid without change in wave-length increases enormously when the substance is in the critical state. Raman himself suggested that an analogous increase occurred with the modified secondary radiation from carbon dioxide, but W. H. Martin afterwards obtained negative results with a mixture of phenol and water (see NATURE, Oct. 6, p. 506; 1928). The question is important, and has now again been attacked by S. L. Ziemecki and K. Narkiewicz-

odko, in Warsaw. Their work, which is outlined in *die Naturwissenschaften* for Nov. 8, was done with e critical mixture of isobutyric acid and water at °. C., with a powerful mercury arc of special con- ruction for the primary source. The Raman lines ne to the acid were found to be present in the attered light, but their intensity was certainly not ore than some 30 per cent above normal, and even is apparent increase may have been due to a heavy ntinuous background in the secondary spectrum. hey point out that this furnishes an experimental roof that the Raman radiation is not coherent. Two rther papers on the Raman effect have also appeared recent issues of the *Indian Journal of Physics*, the ird number of the current volume containing an count of an extended series of observations on odified radiation, by S. Venkateswaran and A. S. anesan, and the fourth number a useful summary nd bibliography of 150 papers on the subject, by r. Ganesan.

International Temperature Scales.—The importance f having an international temperature scale for high emperatures is admitted by every chemist and hysicist. The international temperature scale dopted in 1927 by the General Conference of Weights nd Measures, representing thirty-one nations, is ntended to reproduce, as closely as can be done with ur present knowledge, the Centigrade thermodyna- nic temperature scale—the Kelvin scale. In this cale the temperatures of melting ice and of con- lensing water vapour, when both are under the ressure of one standard atmosphere, are numbered ° and 100° respectively. This scale would be exactly ealised with an ideal gas in a perfect gas thermo- neter. In practice it is closely realised by several of he permanent gases. The gas thermometer, how- ver, is inconvenient for ordinary use. In practice, he results of the best gas thermometer determina- ions have been made permanently available by de- ermining the freezing and boiling points of various ure metals up to the melting point of palladium, hich is about 1550° C. These thermometric fixed oints can be used in defining practical temperature cales with the help of convenient interpolation in- truments. We learn from a paper on temperature cales by W. F. Roeser, published by the U.S. Bureau f Standards (*Research Paper*, No. 99), that the new cale (1927) is the fourth temperature scale used by he Bureau of Standards since 1912. His purpose as to determine how much change it was now ecessary to make so that these scales could be com- ared with one another. The experimental results re highly satisfactory and show that the maximum ifference in the temperature determined by the four cales is only a fraction of a degree Centigrade. The ifference between the temperature of the freezing oint of copper (1083°) and that of gold (1063°) is 0° C., with a maximum inaccuracy of less than the alf of one per cent.

The Calculation and Interpretation of Parachors.—ome years ago S. Sugden showed that the product f the molecular volume by the fourth root of the rface tension of a liquid, called the *parachor*, might e expected to give a molecular volume at temperatures t which the liquids have the same surface tension. his was divided among the atoms of the compound, nd the parachor of a compound could then be epresented as the sum of the parachors of its atoms nd certain constants characteristic of the types of nkages in the molecules. This has led to many nteresting results from the point of view of the tructure of compounds. In the September issue of he *Journal of the Chemical Society*, S. A. Mumford and J. W. C. Phillips show by an extensive survey of the data that, although the atomic constants of Sugden are probably very nearly correct, the change due to an increment of CH_2, and hence of carbon and hydrogen values, which they propose, leads to greater accuracy in the calculated parachors, especially in the case of compounds of high molecular weight. In their scheme also the parachor loses its strictly additive character and becomes definitely constitutive, stresses due to spatial arrangement of, and electrostatic influences between, atoms and groups in a molecule being accompanied by well-defined parachor variations. If these conclusions are substantiated, the value of the parachor method will be increased rather than diminished, since it will be able to throw still more light on the structure of compounds.

Decomposition in a Crystal.—Some very striking results have been obtained by Dr. J. Colvin and Mr. Hume in a study of the process of dehydration in crystals of potassium hydrogen oxalate hemihydrate, $2KHC_2O_4 . H_2O$ (*Proceedings of the Royal Society*, November, p. 635). This substance forms transparent plates of somewhat indefinite form, and decomposition, when it occurs, usually starts at an edge, where it is first evidenced by the appearance of a black dot. The dot then increases in size, and grows as a black area bounded by lines which are parallel, in general, to edges of the crystal. The rate of advance of the black edge in any particular direction can be followed with ease by means of a travelling microscope, and is constant, but occasionally an edge will halt for a few minutes, and then start off again with the same speed as before. The steady rate of advance depends upon the direction in which the reaction is proceeding into the crystal, and varies considerably from one batch of plates to another, but has in all cases a large positive temperature coefficient, equivalent to a heat of activation in the neighbourhood of forty kilocalories.

Bearings and Lubrication.—The commonest component of machinery of all kinds is the journal revolving in a bearing, and the design, construction, lubrication, and maintenance of such bearings present many problems to the engineer. While such investigators as Beauchamp Tower, Osborne Reynolds, Sir John Dewrance, Summerfeld, Michell, and Kingsbury have done a great deal to advance the knowledge of the subject, there is much to be learnt regarding the size, lining, and clearances of bearings, and the properties and working conditions of the lubricants, to which attention was directed in an important paper on "Journal Bearing Practice", by Mr. F. Hodgkinson, read to the Institution of Mechanical Engineers on Nov. 15. The paper and a summary of the discussion which followed is given in both *Engineering* and the *Engineer* for Nov. 22. A few years ago, it was held that the relation which should govern the design of a high-speed bearing was that the pressure in pounds per sq. in., P, multiplied by the velocity of the rubbing surfaces in feet per second, V, should be 2500, but in modern practice, pressures run up to 150 pounds with velocities up to 150 feet. These figures are from steam turbines. It was also formerly considered that the bearing should be cool to the touch, but it was mentioned in the discussion that running the bearings of a certain 41,000 k.w. machine at 140° F. instead of 120° F. led to a saving of coal equal to £142 per annum. One interesting reference in this paper was that made to a gyroscopic stabiliser for a ship, the rotor of which weighed 230,000 lb. and ran at 800 r.p.m. The maximum bearing pressure in this case approximated to 900 lb. per sq. in. of projected surface.

Anniversary Meeting of the Royal Society.

THE anniversary meeting of the Royal Society was held on Nov. 30, and the presidential address delivered by Sir Ernest Rutherford. He referred to the loss by death during the past year of fourteen fellows of the Society and one fellow elected under Statute 12, which provides for the admission of persons who have rendered conspicuous service to science, or whose election would be of signal benefit to the Society. Mention was also made of the retirement of Sir David Prain and Sir James Jeans, treasurer and secretary respectively for the past ten years, during which period the number of pages annually in the *Proceedings* has grown from 700 to 3661, an increase in publication effort due mainly to the activity of Sir James Jeans. Sir Henry Lyons succeeds Sir David Prain as treasurer, and Lord Rayleigh becomes foreign secretary in succession to the former. Sir James Jeans is succeeded by Dr. F. E. Smith, well known for his work at the National Physical Laboratory on electrical standards, and until recently Director of the Scientific Research and Experiment Department at the Admiralty. He has recently been appointed Secretary to the Department of Scientific and Industrial Research, in connexion with which Sir Ernest remarked: "The Council feel that it is an advantage, rather than a disadvantage, that Dr. Smith should hold these two posts concurrently; for, although the main spheres of work of the two bodies are distinct, they have many interests in common in fostering the research activities of the nation".

The report of Council records a legacy, subject to a life interest, of £5000 free of duty, for general purposes, under the will of the late Prof. W. H. Perkin. A new research fellowship has been founded in accordance with the wishes of the late Mr. E. W. Smithson, who bequeathed to the Society a reversionary interest in the residue of his estate, now amounting to about £1200 a year. It has been decided to establish a fellowship at Cambridge for a period of four years in the first instance, and renewable annually up to a maximum of eight years in all, at an annual stipend of £800. The appointment is essentially for research, but permission will normally be given for the fellow to undertake a minimum of actual teaching in order to keep in touch with academic work. The award will usually be limited to British subjects.

Sir Ernest then discussed recent work in physics, referring in particular to the Raman effect and the constitution of hydrogen gas, and emphasising the close connexion between theory and experiment characteristic of modern progress; this appears elsewhere in this issue. The presentation of medals followed, and we print below extracts from the remarks made on the recipients' work.

Presentation of Medals.

Copley Medal, awarded to Prof. Max Planck.

In the first instance, Planck applied the concept of the quantum of action to derive a formula giving quantitatively the distribution of energy in the spectrum of a complete radiator at any temperature, and it was basing upon this that Einstein developed a formula for the atomic heats of solids as a function of the temperature, which laid the foundation for all progress that has been made on this subject in the last twenty years. The concept of quanta of action as applied by Bohr to atomic processes in 1913 has proved of fundamental importance in elucidating the meaning of the complicated spectral series, and it has given an insight into the constitution of the atoms and been able to account for their various properties from first principles. In its most recent developments, Heisenberg has shown that Planck's quanta of action are bound up with an essential indeterminacy of physical measurements, which has the most far-reaching metaphysical consequences. Though his name is not immediately associated with any of these theories, Planck has taken an important part in formulating, clarifying, and criticising these developments of his original idea. It is no exaggeration to say that the development of the idea of the quantum of action, first formulated by Planck nearly thirty years ago, has effected not only a veritable revolution in physics, but also profoundly changed our methods of thought and concepts of philosophy. Quite apart from his work on quanta, Planck's papers and books on other subjects are sufficient to place him in the front rank of physicists.

Royal Medal, awarded to Prof. John Edensor Littlewood.

The various problems which Prof. Littlewood has successfully attacked are characterised by their extreme difficulty. Into certain properties of primes, in which the Riemann zeta-function is employed, he has penetrated further than any other mathematician. Among the results he has obtained in this domain may be mentioned his proof that a conjectural expression given by Gauss for the number of primes less than a prescribed number is false, although its correctness is supported by all empirical evidence for numbers up to a thousand million. He has also obtained the best-known result giving the number of primes less than a prescribed number. In the general theory of series he has obtained various important results, the most celebrated of which is his Tauberian theorem for power-series. He has done much work on the general theory of functions, the earliest of which relates to integral functions of finite or zero order. His theorem that (roughly) a function of sufficiently low order has associated with it circles on which its minimum is of the same order as its maximum, has led the way to many developments by other mathematicians. Another striking piece of work is his extension to real sub-harmonic functions of the theorem due to Fatou, that an analytic function, bonded in the unit circle, tends to a limiting value almost everywhere on the unit circle. The importance and width of the results which have been published by the partnership of Prof. Hardy and Prof. Littlewood must also be referred to; among the subjects which they have treated are additive number theory, especially Waring and Goldbach problems, the theory of the zeta-function, Diophantine approximation, general theory of series, and Fourier's series.

Royal Medal, awarded to Prof. Robert Muir.

Prof. Muir is particularly distinguished for his pioneer work in the study of immunity reactions and mechanisms at a time when the foundations of the science of immunology were being laid, and the combining properties of normal and immune sera with antigen were being submitted to analysis by test-tube methods. Hæmolytic systems were chiefly studied and problems concerned with the specificity, constitution, and dissociation of immune bodies and with the combining properties of complements were attacked by accurate quantitative methods. These studies by Muir and his collaborators are of fundamental importance in the history of the development of the science. Muir's interests, however, have not

en confined to immunology. In the field of general d experimental pathology he has made important ntributions to knowledge, and his researches on perimental anæmia produced by the injection of emolytic serum, and on the regenerative changes the bone marrow in response to infection, are idely known.

DAVY MEDAL, AWARDED TO PROF. GILBERT NEWTON LEWIS.

Prof. Lewis, of the University of California, is stly regarded as one of the leaders of modern hysical chemistry, mainly on account of his re- arkable contributions to chemical thermodynamics. e has been responsible for the development of fresh nd original methods in attacking the problem of emical affinity. By the skilful utilisation of appro- riate experimental measurements, Lewis and his llaborators have shown how the free energy of a reat variety of elements and compounds can be scertained, and how this quantity is related to the ermal and electro-chemical characteristics of chemi- al reactions in which these elements and compounds re involved. It is to Lewis that we owe the concepts f 'activity' and 'activity coefficient', and recent dvances, more especially in our knowledge of the hermodynamic properties of solutions, are the irect outcome of the introduction and development f these ideas. Further, in the closely related field of lectrode potentials, his work, both on the theoretical nd practical sides, has been outstanding. Lewis has endered great service to chemistry by his theoretical ork on electron configuration, and the bearing of his on polarity, valency, and cognate matters. His onceptions in this field and his recognition of the undamental importance of the electron duplet have reatly influenced the development of modern hemical theory.

HUGHES MEDAL, AWARDED TO PROF. HANS GEIGER.

Prof. Geiger, of the University of Tübingen, has made many important contributions to our knowledge of radioactivity. He was the first to examine in detail the scattering of α-particles by matter. His classical investigation, in collaboration with E. Marsden, on the large angle scattering of α-particles in their passage through matter, not only gave a definite experimental foundation to the nuclear theory of the atom, but also led to the suggestion that the properties of an atom are defined by its atomic or ordinal number—a suggestion strikingly verified by the investigations of Moseley. Among many notable researches in radioactivity, special reference may be made to his determination of the ranges of the α-particles from all the radioactive elements with the greatest possible precision. From these measurements we are enabled to deduce the velocity of expulsion of the α-particle from many radioactive bodies. He discovered with Nuttall a remarkable relation between the life of a radioactive element and the velocity of the α-particle ejected from it. This relation, known as the Geiger-Nuttall law, has an intimate bearing on the new theories of the constitution of atomic nuclei. With Sir Ernest Rutherford, Geiger devised an electric method of counting α-particles and determined the number of α-particles emitted by a gram of radium. Later Geiger devised a point detector of great sensibility, which could be used for counting both α-particles and β-particles. Within the last few years he has succeeded in making a new type of detector, by which the liberation of any electron throughout a comparatively large volume is detected. This beautiful device, which has been applied by Geiger himself and by others to the study of the penetrating radiation in the atmosphere, promises to provide a method of great power for extending our knowledge of this radiation.

Forestry in Kenya Colony.[1]

THE Annual Report of the Forest Department in Kenya Colony (to Dec. 31, 1928) directs attention to a fact which is well known in forestry economics, that any serious set-back to the country as whole, whether due to climate, invasions of pests, isease or other troubles, will at once react on the orest sales and revenue. During the year here eviewed, the rains were everywhere much below the verage, and a very serious infestation of locusts ffected all parts of the country. The inevitable consequences followed, as stated in the report: "These wo factors brought about a considerable restriction n trade and development of the Colony, which seriusly affected the sales of timber and the partial rought greatly handicapped the Department's plantng schemes". A check came to the continuous rise n revenue shown since 1926, as also in the rate of lanting. This check is, however, regarded as purely emporary.

In the 1926 report the Conservator alluded to the act that, owing to a paucity of staff, it was impossible o judge of the Colony's forest position as they had no ata upon which to compare the annual cut with the xisting stock of mature timber in the forests. The eviewer of that report in NATURE fully agreed with s author that such a position of affairs was "the most nsatisfactory aspect of the forestry position". In pite of the still existing difficulties due to an inadeuate staff, the past two years have witnessed a deided effort to deal with the large amount of work connected with surveys of the forests and also, it is understood, with that important matter of stock mapping, however roughly, the growing stock of the reserves which are subject to fellings.

To the public outside Kenya, the most interesting factor connected with the forestry of the Colony is the well-known so-called pencil cedar (*Juniperus procera*), in which the report shows there was a large export, namely, 39,551 cub. ft., as compared with 13,548 cub. ft. in the previous year.

"The outlook of this trade", says the Conservator, "appears to be bright, provided only carefully selected, accurately sawn, and thoroughly seasoned slats are shipped and the price is moderate. A process has been developed in England for rapid treatment of the slats which appears to be most successful in seasoning and at the same time slightly softening the wood. The process appears to be a valuable one, which should help the trade considerably. Provided, however, the slats are carefully selected and thoroughly air seasoned, *i.e.* scientifically stacked under properly regulated conditions of air and moisture for, say, twelve months, the wood appears to be entirely suitable for pencil manufacture without artificial treatment.

"It is said that the preparatory treatment of cedar substitutes has made such improvement recently that these substitutes now compare very favourably in quality with cedar. It is not believed that these woods can ever be given quite the unique properties of cedar, but there is no doubt that cedar slats will have to be very carefully produced and at a comparatively low price if they are to compete successfully."

[1] Colony and Protectorate of Kenya. Forest Department Annual eport, 1928. Pp. 32. (Nairobi: Forest Department, 1929.)

It is a relief to know that the Conservator is of opinion that there are very considerable quantities of pencil cedar in the Colony, but that the survey of these is still very incomplete. The existing sawmills with cedar concessions can supply any immediate demands, and it is hoped in the near future to have other areas ready for exploitation.

Mr. H. M. Gardner, who is now the permanent Conservator, and his officers may be congratulated on a report which shows real progress. He is evidently an optimist, for the following extract shows that he has been able to perceive some benefit to forestry in the Colony as a result of the past drought. He writes: "The one satisfactory result of the drought condition prevailing during the year was the very great increase in the public interest in forestry. The preservation of the existing forests and the increase of tree planting both on public and private land have become matters of public discussion throughout the Colony, which can result in nothing but good."

Physics in Fuel Problems.

DR. C. H. LANDER, Director of Fuel Research, delivered one of the public lectures on physics in industry which are arranged by the Institute of Physics, on Nov. 27, taking as his subject "Physics in Relation to the Utilisation of Fuel". Apart from the great development of physical instruments for the control of fuel-using appliances, physics enters into the study of most problems of preparation, treatment, and utilisation of fuel.

The microscope has been effectively enlisted in the examination of coal, both for the study of thin sections by transmitted light, whereby the more resistant plant remains are made visible for identification, and for the investigation of polished surfaces by reflected light. X-ray photography as developed by Kemp has proved very useful in revealing the distribution, nature, and amount of ash in coal, information giving a ready guidance as to the prospects of 'washing' a coal to improve its worth. Again, by means of the X-ray spectrometer, graphite has been identified in cokes of different types, and it has been found possible to correlate the size of the graphite crystals with the reactivity of the cokes as determined by a chemical method used at the Fuel Research Station.

All processes of coal cleaning depend on utilising differences between the physical properties of the coal and the impurity to effect a separation. Difference in density, size, shape, friction, resiliency, and surface tension to water have all been used for this purpose. These applications were illustrated by description of the principles of the different methods of wet and dry cleaning.

Dr. Lander referred to the influence of the manner in which heat is applied on the process of carbonisation in retorts, and then turned to the physical principles of the utilisation of fuel. In order to reduce the size of the combustion chamber of furnaces fired by pulverised fuel, it has been considered advisable to create turbulence in the fire gases. Dr. Lander questioned whether uncontrolled turbulence will prove a satisfactory a solution as to obtain stable stream-line motion of air, and to induce the particles of fuel to move across the stream line in a controlled manner this might perhaps be attained by giving a vortical motion to the air admitted at the perimeter of the chamber while the products are withdrawn axially. The fuel would be admitted at any convenient point or points, and the particles would be compelled to cross the stream lines in a stable manner.

The physics of the fuel fired furnace is complicated by the fact that it involves transfer of heat from moving gases. Unfortunately, the complications are such as to prevent the treatment of the problem by 'models', as in aerodynamical research. In such furnaces, in addition to the flow of combustion gases heat interchange by conduction, forced and natural convection, and radiation are occurring. So complex are the conditions that reliance has usually to be placed on empirical formulæ of limited application but progress is being made to place these on a more fundamental basis. H. J. H.

Undulant Fever in England and Wales.

UNDULANT fever was regarded thirty years ago as a sub-tropical disease almost confined to the Mediterranean coast-line and islands; hence the old name of Mediterranean or Malta fever applied to the disease. It has now been recognised in every continent, with the possible exception of Australia.

The causative micro-organism of undulant fever is a micrococcus (*M. melitensis*), first described by Bruce in 1886 (though some regard it as a bacillus), and is spread almost entirely by goats' milk. In 1897, Bang of Copenhagen described under the name *Bacillus abortus* a micro-organism causative of contagious abortion in cattle. Research during the last few years has directed attention to the close similarity between *M. melitensis* and *B. abortus*, and inasmuch as *B. abortus* is frequently present in cows' milk, the question has arisen whether this organism may not cause a form of undulant fever in man. As a result of close clinical and bacteriological study of cases of irregular fever occurring in Great Britain, on the Continent, and in America, it has been shown that man is occasionally infected with the contagious abortion organism with the production of a form of undulant fever.

An exhaustive report on the subject by Capt. Dalrymple-Champneys has been issued by the Ministry of Health ("Undulant Fever." *Reps. on Pub. Health and Med. Subjects*, No. 56. London: H.M. Stationery Office. 1*s.* 6*d.* net), and it is found that at least 14 authentic cases of undulant fever in man caused by the *abortus* variety of the organism have originated in England. Many cases have been described in Denmark, some in Germany, and a number in America (366 cases this year, according to a *Daily Science News Bull.* issued by Science Service, Washington, D.C.). Contagious abortion is also widespread among animals other than the cow, namely, the sheep, pig, goat, horse, and dog, the causative organisms being of the *abortus* type, but sometimes presenting minute differences, so that several varieties exist.

Dr. Forest Huddleson has published a valuable contribution on the differentiation of these varieties, or species as he prefers to call them (*Technical Bull.*, No. 100, 1929. Agricultural Experiment Station, Michigan State College). The organisms are placed in a genus *Brucella*, which is divided into three main species, namely, *Br. abortus* (Bang), *Br. suis* (Traum),

and *Br. melitensis* (Bruce), as they show distinct differences from one another. Some 6-9 per cent of samples of English milk contain *Br. abortus*, yet undulant fever from this source is a rarity. The explanation of this apparent anomaly may be that this organism is of low virulence for man. Thus, it is difficult to infect monkeys with *Br. abortus*, whereas both *Br. melitensis* and *suis* are highly infective for this animal. The Americans are, therefore, disposed to attach more importance to the porcine than to the cattle strain of *Brucella* as a source of undulant fever in man derived from animals other than the goat.

University and Educational Intelligence.

CAMBRIDGE.—The Vice-Chancellor has announced that he has appointed Prof. Hermann Weyl, professor of higher mathematics in the Technical High School, Zurich, to be lecturer on Mr. Rouse Ball's foundation for the present academical year.

EDINBURGH.—At the meeting of the University Court on Monday, Nov. 25, on the recommendation of the Senatus, Dr. J. E. Mackenzie, reader in chemistry, was appointed to membership of the Senatus, and Dr. C. H. O'Donoghue, lecturer in zoology, was appointed reader with a seat on the Faculty of Science.

MANCHESTER.—The following honorary research fellows have been appointed: Dr. W. L. Dulière (Louvain), in physiology; Mrs. Wright Baker (Manchester), in botany; Miss Isabel Cookson (Melbourne), in botany; Dr. Stephen Náray-Szabó (Budapest), in physics; Prof. Linus Pauling (Pasadena, California), in physics; Mr. Joseph West (Manchester), in physics.

Mr. Harold Walkden has been elected to a Research Studentship in Botany.

AT the annual meeting of the court of governors of the London School of Hygiene and Tropical Medicine, held on Nov. 27, the board of management of the School presented its fifth annual report. In the year under review, ended July 31, 1929, the new home of the School, its equipment, and the development of its organisation advanced steadily towards completion, and on July 18 the Prince of Wales formally opened the new building. Special reference is made in the report to the new course of study designed to prepare candidates for the examination for the diplomas in public health, and especially the new academic diploma instituted this year by the University of London. This course is planned in a broad, practical spirit, and gives promise of a great advance on anything which has hitherto been systematically attempted with regard to public health teaching. Two large centres of public health administration have been secured as demonstration areas, an advisory committee of experts of the first standing in the public health service appointed, and a scheme of special lectures arranged. The courses of study in tropical medicine and hygiene are maintained at a high level, and include a special short course in hygiene for business or professional men and women proceeding to the tropics. The University Grants Committee has intimated that the Treasury has sanctioned a recurrent grant-in-aid at the rate of £40,000 a year, but impresses upon the School the necessity for taking all possible steps to secure an increased private income from the Colonies, from public or private subscriptions, and in other ways.

Calendar of Patent Records.

December 8, 1823.—The waterproofing industry dates from the patent granted to Charles MacIntosh for his "process and manufacture whereby the texture of hemp, flax, wool, cotton, and silk, and also leather, paper, and other substances, may be rendered impervious to water and air", the specification of which was enrolled on Dec. 8, 1823. The process, which consisted in placing a sheet of rubber (formed by dissolving small pieces of rubber in naphtha and allowing the solvent to evaporate) between two layers of fabric, was very successful, and MacIntosh's goods quickly attained a high reputation.

December 9, 1815.—The original gas-meter of Samuel Clegg was patented on Dec. 9, 1815. The apparatus consisted of a rotating wheel with a hollow rim connected by hollow arms with inlet and outlet passages for the gas in the axle, and provided with a water seal which closed the inlet and opened the outlet at the proper moment so that the number of revolutions of the wheel was a measure of the quantity of gas passing through. It was greatly improved later, but did not become commercially successful until towards the end of the patent term. The validity of the patent was established in the courts in an action for infringement.

December 10, 1779.—James Keir, F.R.S., doctor, soldier, manufacturer, and chemist, was granted a patent on Dec. 10, 1779, for "a compound metal capable of being forged, more fit for the making of bolts, nails, and sheathing for ships than any metal heretofore used for those purposes". The new alloy—which contained 54 per cent copper, 40·5 per cent zinc, and 5·5 per cent iron—was brought to the attention of the Admiralty by Mathew Boulton (who called himself the joint inventor), and a ship—the *Juno* frigate—was placed at Keir's disposal for a trial. The requisite number of plates and bolts were made, but there is no further record of the experiment. Keir's metal does not appear to have been referred to in the litigation on the Muntz metal patent sixty or so years later.

December 10, 1782.—The "new invented method of making small shot solid throughout and perfectly globular in form" by pouring the melted metal from a height into water was patented by William Watts, a plumber of Bristol, on Dec. 10, 1782. The process was adopted with success and was in general use by the end of the century.

December 10, 1845.—The first pneumatic tyre was patented by Robert William Thomson on Dec. 10, 1845, and consisted of a hollow belt composed of several thicknesses of canvas saturated with rubber solution and cemented together, the whole being then vulcanised. The cover was of leather. A set of the tyres is said to have run for 1200 miles without deterioration. Dunlop's patent, on which the present industry is based, was not granted until 43 years later.

December 11, 1863.—The ammonia-soda method of making sodium carbonate was made commercially successful by the process invented by Ernest Solvay and patented by him in Great Britain on Dec. 11, 1863. A factory was opened at Charleroi in 1865, and the industry quickly became established and finally ousted the Leblanc process. Brunner, Mond and Co., at their works at Northwick, were the first in England to adopt the new process.

December 12, 1885.—The incandescent gas mantle was patented in Great Britain by the late Karl Auer von Welsbach of Vienna, the inventor, on Dec. 12, 1885. The first mantle to reach England was brought over in a bird-cage by a woman, who refused to let the cage go out of her hands during the journey.

Societies and Academies.

LONDON.

Mineralogical Society, Nov. 6.—**C. E. Tilley**: On scawtite, a new mineral from Scawt Hill, Co. Antrim (with chemical analysis by Mr. M. H. Hey). This new monoclinic mineral, with composition $6CaO \cdot 4SiO_2 \cdot 3CO_2$, occurs in the contact zone between the chalk and tertiary dolerite, from which another new mineral, larnite, was recently described (*Min. Mag.*, vol. 22, p. 77).—**F. Coles Phillips**: On the composition-plane of [010]-twins in the acid plagioclases. In the true pericline twin, the inclination of the variable composition-plane for different composition is correctly given by Wulfing's curve. T. Barth's conclusion that there is no regular variation is not justifiable, and results partly from confusion with other twin-laws such as that of acline *A*. The pericline twin should be of frequent occurrence in the crystalline schists.—**M. H. Hey**: On the variation of optical properties with chemical composition in the rhodonite-bustamite series. A complete optical study of three analysed members of the rhodonite-bustamite series, with the data available from the literature, shows regular variation in the optical properties and specific gravity with change in lime content.—**F. Coles Phillips**: A preliminary account of some mineralogical and chemical changes induced by progressive metamorphism in the Green Bed group of the Scottish Dalradian. Analyses prove the Green Beds to be a truly isochemical series in respect of the constituents significant in progressive metamorphism. The earliest-formed plagioclase is pure albite, but a progressive entry of the anorthite molecule can be traced. The adjustment to equilibrium is apparently close, all the reconstituted plagioclase of a given rock having the same composition. In the highest grades the felspar is a medium andesine. Similar variations with increasing grade are found in the associated epidiorites. The earliest-formed greenish micaceous mineral is a true potash mica, which undergoes increase in FeO in higher grades. Hornblende appears in the chlorite-zone only in rocks low in potash.

Optical Society, Nov. 14.—**A. G. Frewin**: (1) The Busch optometer (eye refractor) designed by Prof. Thorner; (2) A glare-free, reflexless, stereoscopic hand ophthalmoscope. The new ophthalmoscope has a concave mirror which focuses a source of light on the lower part of the patient's dilated pupil. The optical system is such that the two pupils of the observer are conjugate with two separated points just above the image of the light. The action is thus similar to that of a policeman peering through a small window-pane into a dark room which he illuminates with his bull's-eye.

PARIS.

Academy of Sciences, Oct. 28.—**A. Cotton**: The problem of asymmetric synthesis and the combined actions of polarised light and of a magnetic field on certain photographic plates.—**Georges Claude**: The first attempts to realise at Cuba a Claude-Boucherot apparatus. An account, with photographs, of the first unsuccessful attempt to launch a tube, 2 metres in diameter and 2 kilometres long, in the bay of Matanzas, Cuba.—**Pierre Weiss** and **R. Forrer**: The magnetisation to saturation of ferrocobalts and the atomic moments of iron and of cobalt. The magnetisation to saturation of 25 cobalt-iron alloys, ranging from 0 to 100 per cent cobalt, is described. The results are given graphically.—**J. Herbrand**: The limited solutions of certain functional equations.—**P. Dubreil**: Some complements to the theory of Nœther.—**J. A. Lappo-Danilevski**: The explicit expressions of the invariants of a monodrome group of a system of linear differential equations with arbitrary rational coefficients.—**N. André Roussel**: The generalised primitive of a function.—**Victor Vâlcovici**: The generalisation of the theorem of energy.—**Joseph Pérès**: Concerning the fundamental problem of the theory of vortices.—**William Loth**: Remarks on the guiding of ships or aeroplanes by directed waves.—**L. Décombe**: The mechanism of emission and Melde's experiment.—**Paul Jayles**: The electrolytic chlorination of benzene in methyl alcohol solution. Electrolysis without a diaphragm gave monochlorbenzene as the main product with a small proportion of benzene hexachloride. The same products were obtained in higher yields using a diaphragm.—**M. Laporte** and **La. Goldstein**: Activation in the rare gases.—**A. Gillet** and **D. Guirchfeld**: The existence of a chemical equilibrium in autoxidation. In the direct oxidation by oxygen gas, in air, experiments are described in support of the view that there exists for each temperature an equilibrium pressure of oxygen below which no fixation of oxygen upon the autoxidisable body takes place.—**René Dubrisay** and **Albert Saint-Maxen**: The autoxidation of hydroquinone. Measurements giving the rate of oxidation of solutions of hydroquinone as a function of *p*H.—**Mme Ramart-Lucas** and **J. Hoch**: The comparative stability of the ethylenic stereoisomers and syntheses by ultra-violet rays.—**Gaston Rapin**: The action of some dioxides on very dilute aqueous solutions of potassium permanganate.—**L. Palfray** and **B. Rothstein**: The halogen derivatives of 1·4 cyclohexanediol (quinite). These can be obtained by the interaction of quinite and halogen acid.—**A. Pereira Forjas**: The spectrochemistry of Portuguese mineral waters. The water of Cambres. In addition to the ions detected by ordinary chemical methods, the spectroscope revealed the presence of radium, lead, uranium, vanadium, zinc, copper, germanium, and possibly thallium.—**Daniel Chalonge** and **F. W. Paul Götz**: Diurnal and nocturnal measurements of the quantity of ozone contained in the upper atmosphere. Measurements made at Paris and at Arosa by the spectrographic method, showed that at these places the presence or absence of the sun caused no notable change in the thickness of the ozone layer.—**A. Guillaume**: The alkaloid losses in the course of drying plants under varied conditions.—**Jules Amar**: The hemopneic coefficient and its applications.—**F. Obaton**: The relation between the nature of the glucides of *Sterigmatocystis nigra* and that of the sugars supplied to it. There is a correlation between the nature of the product made by the *Sterigmatocystis* and the sugar supplied as food to the mycelium. This relation is more marked between glucose and trehalose than between lævulose and mannitol.—**H. Pénau** and **G. Tanret**: The mercury reducing power of normal urine. The mercury reducing figure, although admittedly arbitrary, furnishes data which may be of service in the examination of urine.—**R. Fosse**, **A. Brunel**, and **P. de Græve**: Allantoinase and the origin of allantoic acid in plants.—**G. Ramon**: The production of a very active diphtheric toxin. The usual method of preparation is modified by the addition of a certain proportion of glucose. A toxin of high activity is obtained.

ADELAIDE.

Royal Society of South Australia, Oct. 10.—**Thomas T. Colquhoun**: Polarity in *Casuarina paludosa*. Portions of bark of a young tree were removed, turned end for end and regrafted. The resultant shoots were tested for growth of roots unsuccessfully. The grafts

were removed and sectioned, the junction between the normal wood and inverted wood being marked by abnormal twisting of the trachæ and trachieds, suggesting that translocation effects required the same orientation of the conducting strands.—**J. G. Woods**: Floristics and ecology of the mallee. The mallee is a transition region between the savannah forests of the southern wetter districts and the Eremian or northern communities of saltbush and mulga. The geographical range of the chief tree species (*Eucalyptus spp.*) is sharply limited by the 20-inch isohyet in the south and the 8-inch isohyet in the north. In New South Wales its northern limit is determined by the northern limit of winter rains. The soils are all alkaline (*p*H about 8·0) and all contain nodular travertine limestone. Analysis of the growth forms gives a spectrum showing preponderance of woody shrubs and undershrubs of pronounced sclerophyll type and with a large therophytic element. Of the total number of species only about 25 per cent are confined to the mallee; the rest are migrants from the northern and southern communities.—**Albert H. Elston**: Australian Coleoptera (Part 6). Names and describes three new species of Elateridæ and one new genus and seven new species of Cleridæ.

Cape Town.

Royal Society of South Africa, Sept. 25.—**J. C. Vogel**: The cause of the Russell effect observed in oils. On exposing moist starch potassium iodide paper near oils of animal, vegetable, and mineral origin, iodine stains develop. The intensities of the stains produced by different oils are proportional to the intensities with which they act on photographic plates exposed near them (Russell effect). The reaction only takes place in the presence of oxygen. The liberation of iodine is due to the liberation of volatile oxidation products consisting of normal fatty acids containing four or more carbon atoms. The Russell effect and the supposed photoactivity of oils is due to the reducing properties of the vapours of these acids.—**H. Spencer Jones**: The secular variations of the orbital elements of the inner planets. Recent determinations of the change in the obliquity of the ecliptic indicate an appreciable correction to Newcomb's value, which can be accounted for by an error in his adopted mass of Venus. If the revised mass of Venus is adopted, the mass of the earth deduced from the secular variations of the orbital elements corresponds to a still smaller value of the solar parallax. The discordance can be traced to the motion of the node of Venus upon which the mass of the earth obtained from the secular variations almost entirely depends. With the most probable system of masses, the discordance between the observed and theoretical motions is six times the probable error. The motion of the node of Venus is the only remaining outstanding discordance between theory and observation in the planetary elements.—**B. de St. J. van der Riet** and **G. W. B. van der Lingen**: The wax of the rhenoster bush (*Elytropappus Rhenocerotes*). The air-dry tips of Rhenoster bush collected at Stellenbosch were found to yield on extraction with volatile organic solvents up to about 10 per cent of wax-like material. The yield and nature of the 'wax' varied according to the solvent used for extraction.—**F. C. Cawston**: The problem of the ventilation of iron roofs in the tropics. The present system of ventilating iron roofs is very inadequate and a cowl on the summit is insufficient unless there is a corresponding provision of air inlet. This inlet should be provided by means of a ventilating shaft inserted on a slant at each corner of the roof to supplement adventitious draughts.

Leningrad.

Academie des Sciences (*Comptes rendus*, No. 16).—**W. Willams**: Action of nitric acid on dihydroperillamine. Cyclical primary amines of the terpene series with the NH_2 group in the side chain are able, like the polymethylene primary amines, under the influence of nitric acid, to isomerise with the increase in the cycle by one atom of carbon.—**V. Feofilaktov**: The condensation of pyruvic acid with formaldehyde in the presence of sulphuric acid. The usual idea, that the product of the condensation is a tetramethylene-1:3-dioxalic acid, namely, $C_8H_8O_6$, is erroneous; there are two products, and one of them, mistaken for $C_8H_8O_6$, has actually the formula $C_9H_8O_6$ and the structure of a methylene-bis-α-tetronic acid.—**B. Numerov** and **N. Samsonov**: Results of gravimetric observations made in 1928 near Lake Baskuntchak. A gravitational survey of the area revealed the presence of several anomalies which must depend on the geological strata, but the area surveyed was not sufficiently extensive.—**B. Numerov** and **B. Kozlovskij**: Results of gravimetric observations made in 1927–28 in the Emba area. Minimums of gravitational force in the area surveyed correspond to the places where more ancient strata, namely, Permotriassic, come near the surface, while the oil-bearing strata are somewhat removed from them. The greatest negative anomaly indicates the presence of salt-bearing strata.—**N. Nasonov**: Notes on *Phlebotomus* (3). A gradual increase in the numbers of sand-flies in the Crimea which has been observed during the last fifty years is due to the gradual progressive desiccation of the peninsula caused by the deforestation of the Yaila mountains.—**P. Schmidt**: The subfamily Blepsiinæ (Pisces, Cottidæ) in the Pacific. The following forms occur in the North Pacific: *Blepsias cirrhosus* Pall., *B. cirrhosus* sbsp. *draciscus* Jord. and Starks; *B. bilobius* C.V. (= *Histiocottus bilobus* C.V.); *Nautichthys oculofasciatus* Gir. (= *Nautiscus pribilovius* Jord. and Gilbert).

Prague.

Czech (Bohemian) Academy of Sciences and Arts (Second Class, Natural Sciences and Medicine), Oct. 18.—**Dr. Sedláčková**: Influence of choline on the glycoregulation of tissues.—**V. Vondráček**: Characterology from the medical viewpoint.—**A. Jílek** and **J. Lukas**: Electroanalytical determination of thallium as thallic oxide. The anodic deposit from solutions of thallous nitrate in presence of hydrofluoric acid and hydrogen peroxide consists practically of $Tl_2O_3 \cdot HF$; this may serve for quantitative estimation; in the presence of alkali salts the results are somewhat higher.—**K. Kavina**: Virescence of flowers of *Anthriscus cerefolium* Hoffm. subspec. *trichospermus* Schult.—**R. Šimůnek**: The resistance of electrolytes to high frequency oscillating currents. In an oscillating circuit the presence of electrolyte increases its high frequency resistance. It was measured at wavelengths of 600, 300, 150 metres and compared with the value calculated from J. J. Thomson's formula; the agreement was satisfactory. The method is electrodeless.—**K. Koutský**: The quadratic character of numbers and the generalisation of a certain Lagrange rule of the partition of quadratic residues.—**J. Rasch**: Influence of fatty acids on the maximum of current due to atmospheric oxygen in electrolysis with the dropping mercury cathode. The maximum is greatest when the ionic concentration is *ca.* $0{\cdot}5 \times 10^{-3}n$, as in solutions of strong electrolytes. Undissociated molecules have the greater effect in suppressing the maximum the higher the acid; anions of lower acids are indifferent like those of strong electrolytes; palmitate and stearate molecules and ions

have great suppressor activity, due to their abnormally great adsorbability. From the suppressor action a measure for the adsorbability of the acids in the mercury-solution interface is derived.—**Milovidov**: Influence of radium rays on the chondriosome of vegetable cells.—**K. Dusl**: Mathieu functions.—**E. Votoček and S. Malachta**: A new transition from sugars to the furane group. Transition of 5-keto-rhamno-lactone into the methyl ester of the methoxy-methyl-furane-carboxylic acid has been effected by methyl alcohol and hydrochloric acid.—**L. Borovanský-O. Hněvkovský**: Growth of the body and the progression of ossification in boys from birth up to nineteen years of age.

Nov. 8.—**O. Tomíček and A. Jánský**: Determination of halogenides in presence of sulphites. In solutions of the normal sulphites only the iodide can be exactly estimated; in the presence of bisulphites the bromide is also exactly determinable; in fairly acidic solutions all the three halides are determinable. —**O. Tomíček and A. Jánský**: The determination of iodides and bromides in chlorides. Traces of iodide can be estimated directly by silver even in solutions containing 1 mgm. I′ per litre of a 10 per cent NaCl solution. Winkler's apparatus and method for the isolation of bromides from chlorides has been improved.—**A. Orlov**: Wavellite from Černovice near Tábor (in south Bohemia).—**B. Hostinsky**: The probability of phenomena joined into Marek's chains. —**K. Žlábek**: Dependence of the form of musculus digastricus mandibulæ of man and anthropoid apes on the mechanism of the jaw-bone joint.—**B. Hejda and A. Vančura**: Urogenetic coefficients in liver diseases.

SYDNEY.

Royal Society of New South Wales, Oct. 2.—J. A. Cresswick and S. W. E. Parsons: The testing of lead azide detonators. The ballistic pendulum was used so that a direct reading might be obtained of each shot fired. As a preliminary, charges of 10 grams each of standard non-gelatinous powders were fired, using alternatively the aluminium and copper type detonators. The same explosives were then desensitised with liquid paraffin, to determine the point at which one type of detonator would fire the charge whilst the other type failed. After a lapse of two months the mixtures were again tested, using aluminium detonators, and in each case complete detonation of the charge resulted, with same development of power as when previously made. The results prove that aluminium (lead azide) detonators, as at present imported into Australia, are slightly more efficient as initiating agents than the older copper (mercury fulminate) type of the same number.—**J. C. Earl**: The action of acids on diazoaminobenzene. Diazoaminobenzene, when acted upon by acids, yields, according to the conditions, aminoazobenzene or phenyl diazonium salts and aniline. The detection of an intermediate product is described, with experiments showing the profound effect of very small quantities of acids on diazoaminobenzene. The employment of carbon dioxide to liberate the nitrous acid required for the preparation of diazoaminobenzene is advised.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 15, No. 9, Sept. 15).—**Elery R. Becker, J. A. Schulz, and M. A. Emmerson**: A comparative study of the digestion of proteins and carbohydrates in goats during infusoria-free and -infected periods. Infusorian infection gives no significant advantage.—**Benjamin Kropp**: The melanophore activator of the eye. An investigation by blood-transfusion methods of the hypothesis that the blood carries an activator. Extracts of eyes of dark-adapted *Rana clamitans* tadpoles injected into the abdominal cavity of light-adapted tadpoles induced melanophore expansion. Probable source of the activator is the retina.—**F. Simon and E. Vohsen**: Note on Mr. King's paper: "The crystal structure of strontium".—**Roscoe G. Dickinson and Robert T. Dillon**: The Raman spectrum of gypsum. Comparison of the spectrum with that of an aqueous solution of ammonium sulphate.—**Robert T. Dillon and Roscoe G. Dickinson**: Raman spectra from acetone. Results do not agree with those obtained by Williams and Hollaender.—**F. O. Rice and R. E. Vollrath**: The thermal decomposition of acetone in the gaseous state. Pure dry nitrogen saturated with acetone was passed at a known rate through a quartz tube in an electric furnace at 630° C. About 60 per cent of the acetone decomposed is recovered as ketene ($CH_2 : CO$). This result is not in accord with investigations in which rate of change of pressure is measured.—**Donald Statler Villars**: The equilibrium constants of reactions involving hydroxyl.—**Linus Pauling**: On the crystal structure of the chlorides of certain bivalent elements. Using results published by Bruni and Ferrari from powder data, it is deduced that cadmium and other divalent chlorides have a structure in which each cation is surrounded by six chloride ions approximately at the corners of a regular octahedron, six edges of which are shared with other octahedra so as to form a layer.—**L. H. Adams and R. E. Gibson**: The elastic properties of certain basic rocks and of their constituent minerals. Compressibilities, at pressures between 2000 and 12,000 megabaryes (1 megabarye = about 1 atmosphere) were measured by submitting specimens to hydrostatic pressure in a steel cylinder and determining decrease in volume. For basic rocks, it seems that compressibility calculated from mineral content gives a limit to which that of rocks approaches at high pressure. The maximum velocity of longitudinal waves through such rocks at 15,000 megabaryes and 30° C. is 7·4 km. a second. Garnet and jadeite have low compressibilities, indicating that eclogites transmit such waves at greater velocities.—**A. Oppenheim**: The minima of indefinite quaternary quadratic forms.—**G. A. Miller**: On the number of cyclic subgroups of a group.—**Henry P. Thielman**: On new integral addition theorems for Bessel functions. —**George D. Snell**: Dwarf, a new Mendelian recessive character of the house mouse. Mature individuals are about one-quarter the size of normal adults, are fairly healthy though subnormally active, and apparently sterile.—**Sophia Satina and A. F. Blakeslee**: Criteria of male and female in bread moulds (Mucors). There is no constant vegetative difference between gametangia of dicœcious species, and an attempt to differentiate between them by imperfect sexual reactions failed.—**H. W. Leavitt, J. W. Gowen, and L. C. Jenness**: (1) Influence of aluminium on mortar strength. As aluminium content of sand increases from 0·25 per cent to 3·75 per cent, the tensile strength of mortar increases by more than 100 pounds; compression strength is not affected. (2) On the joint influence of iron and aluminium in native sands on mortar strength. The total correlation coefficient is +0·538. An equation is deduced: Mortar strength = 20 aluminium (per cent) + 43 iron (per cent) + 272. There must be chemical interaction between sand and cement.—**Roy J. Kennedy**: Planetary motion in a retarded Newtonian potential field. The idea corresponding to that of effective charge developed by Lienard and Wiechert in electro-magnetism is applied to gravitation.—**J. H. Van Vleck**: On the vibrational selection principles in the Raman effect.

Official Publications Received.

BRITISH.

Proceedings of the Cambridge Philosophical Society. Vol. 25, Part 4. Pp. 369-540. (Cambridge: At the University Press). 7s. 6d. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 395, November. Pp. 1269-1336+xxxviii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Ministry of Health. Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122 C/T.) Pp. 21. (London: Ministry of Health.)

Tanganyika Territory. Tsetse Research Annual Report for the Year ended 31st March 1929. Pp. 18. 2s. 6d. Tsetse Reclamation Annual Report for the Year ended 31st March 1929. Pp. 10. 1s. 6d. (Dar es Salaam: Government Printer.)

Department of Agriculture, Ceylon. Bulletin No. 86: The Control of "Calotermes" in Living Plants. By F. P. Jepson. Pp. 11. 40 cents. Leaflet No. 57: Green Manuring with particular reference to Coconuts. Pp. 10. 5 cents. (Peradeniya.)

FOREIGN.

Department of the Interior: U.S. Geological Survey. Bulletin 799: Geology of the McCalls Ferry-Quarryville District, Pennsylvania. By Eleanora Bliss Knopf and Anna I. Jonas. Pp. xiii+156+8 plates. 35 cents. Bulletin 808: Geology of the De Queen and Caddo Gap Quadrangles, Arkansas. By Hugh D. Miser and A. H. Purdue. Pp. xi+195+18 plates. 75 cents. Bulletin 809: Formulas and Tables for the Construction of Polyconic Projections. Compiled by C. H. Birdseye. Pp. v+126. 25 cents. Bulletin 810-C: The Mount Spurr Region, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1927-C.) Pp. ii+141-172+plates 3-4. Bulletin 811-B: Recent Mining Developments in the Creede District, Colorado. By Esper S. Larsen. (Contributions to Economic Geology, 1929, Part 1.) Pp. ii+89-112+plate 26. 10 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 599: Ground Water in Yellowstone and Treasure Counties, Montana. By George M. Hall and C. S. Howard. Pp. vi+118+7 plates. 25 cents. Water-Supply Paper 600: Geology and Ground-Water Resources of Central and Southern Rosebud County, Montana. By B. Coleman Renick; with Chemical Analyses of the Waters, by H. B. Riffenburg. Pp. x+140+12 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

CATALOGUES.

The Nickel Bulletin. Vol. 2, No. 5, November. Pp. 129-176. (London: The Mond Nickel Co., Ltd.)

Books Beautiful. Pp. 32. (London: George G. Harrap and Co., Ltd.)

Annotated and Classified Catalogue of Works on Mathematics, Astronomy and Physics, with an Appendix of Rare and Valuable Books, including the Newton Library. (No. 816.) Pp. 160. (London: Henry Sotheran, Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 6.

INSTITUTION OF WATER ENGINEERS (at Institution of Civil Engineers), at 10.30 A.M.—R. C. S. Walters: The Hydro-geology of the Chalk of England.—Prof. E. Morton: Some Problems in Hydro-geology.—Discussions on Reports of the Advisory Committee on Water of the Ministry of Health; Second Report of the Legislation Sub-Committee; Report on Rural Water Supplies; Draft Report of a Sub-Committee of the Council on Stream Flow and Underground Water Records.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—J. P. Davidson: The Manufacture of Tobacco.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 6.—Prof. Dempster Smith: Cutting Capabilities of Lathe Tools.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of Rubber Industry) (at Engineers' Club, Manchester), at 7.—H. C. Young: The Common Factors of Technical and Works Controls in the Rubber and Chemical Industries.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Dr. C. V. Drysdale: Alternating-Current Potentiometers and their Applications.

INSTITUTION OF LOCOMOTIVE ENGINEERS, LONDON (at Manchester Literary and Philosophical Society, Manchester), at 7.—J. W. C. Armstrong: Pulverised Fuel Locomotives.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. A. Tookey and others: Diesel Engine Developments.

BRITISH NON-FERROUS RESEARCH ASSOCIATION (at Chamber of Commerce, Birmingham), at 7.—D. M. Smith: Spectroscopic Analysis of Metals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Bairstow and others: Discussion on How can the Pictorial Group best help the would-be Pictorialist?

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—A. B. Gowring: The Demolition of Lambeth Bridge.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—J. A. Steers: The Great Barrier Reefs and the Queensland Coast: a Geographical Reconnaissance (Lecture).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Discussion on Anæsthesia in Rectal Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Hugh Walpole: The Novel and the Creative Spirit.

SATURDAY, DECEMBER 7.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Exeter), at 3.—Lieut.-Col. E. J. Stead: The Local Government Act, 1929.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1) at 3.—W. H. Spreadbury: Some Birds of London's Country.

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow), at 3.—B. A. Peach: The Lochaber Water Power Scheme and its Geological Aspect.—Discussions on S. Mavor's paper on Recent Progress in Underground Conveying and J. E. Lambert's paper on Some Notes on Colliery Blasting Practice.

MONDAY, DECEMBER 9.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. R. Rawlings and T. C. Gilbert: Discussion on To Earth and not to Earth.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—B. A. Pountney: Common and Uncommon Boiler Troubles.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Prof. W. L. Bragg: X-ray Optics (Lecture).

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—Dr. S. G. Barker: Production of the Ideal Textile Fabric.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. L. Cassidy: Melting Furnaces.

SURVEYORS' INSTITUTION, at 8.—W. E. A. Bull: The Landlord and Tenant Act 1927 in Operation.

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8.—C. A. Wood: Birds of Middlesex.

MEDICAL SOCIETY OF LONDON, at 8.30.—W. Trotter and others: Discussion on The Treatment of Head Injuries.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Gloucester).

ROYAL IRISH ACADEMY (Dublin).

TUESDAY, DECEMBER 10.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5.—Dr. J. W. Trevan, Dr. T. Izod Bennett, Dr. D. T. Davies, Dr. L. E. H. Whitby, and others: Phenylhydrazine in the Treatment of Polycythæmia.—Dr. B. Schlesinger, Dr. F. J. Poynton, and others: Nirvanol in the Treatment of Chorea.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Gillespie: The Engineer in Relation to the Petroleum Industry.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Vice-Admiral Sir Robert Dixon: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Dr. G. C. Simpson: Lightning (Kelvin Lecture).

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum), at 7.—Discussion on Problems in Illuminating Engineering, opened by a series of short contributions on different subjects, including The Lighting of Large Vertical Surfaces, A. Cunnington; The Lighting of Operating Tables in Hospitals, E. Stroud; A Large Gas-Lighted Sign Outside Watson House, F. C. Smith; The Lighting of the Savoy Theatre and Hotel, Prof. H. Robertson and B. Ionides.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—Helen Messinger Murdoch: The World in its True Colours.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Dr. B. P. Haigh: The Relative Safety of Mild and High-Tensile Steels under Alternating and Pulsating Stresses.

ELECTRICAL POWER ENGINEERS' ASSOCIATION (Edinburgh Section) (at North British Station Hotel, Edinburgh), at 7.30.—R. H. Rawll: The Electrical Equipment of Factories (Lecture).

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. T. Griffiths: Nickel in Non-ferrous Foundry Alloys.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—T. A. Joyce and E. L. Gruning: The Expedition of the British Museum to British Honduras, 1929.

ROYAL SOCIETY OF MEDICINE (Psychiatry and Disease in Children Sections), at 8.30.—Discussion on The Difficult Child.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Dr. S. S. Pickles: Rubber Manufacture (Lecture).

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.

WEDNESDAY, DECEMBER 11.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—C. Rowntree and others: Discussion on Complications of Operations for Piles.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—A. H. Barker: The Heating of Buildings by Electricity off Supply Mains, with Special Reference to the Problem of Heat-Storage and Off-Peak Loads.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Northern Ireland District) (at Municipal College of Technology, Belfast), at 6.45.—R. B. Donald: Town Planning.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—L. H. Sensicle: Fuel Gas Technique—Some Modern Developments.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry: Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—J. A. Watson: The Industrial Minerals of Scotland.

ROYAL SOCIETY OF ARTS, at 8.—Major C. Wheeler: Overheads and other Factors influencing Road Transport Costs, from an Engineer's Viewpoint.

FARADAY SOCIETY (jointly with the Electroplaters' and Depositors' Technical Society) (at Northampton Polytechnic Institute), at 8.—B. Clark and E. O. Jones: The Effect of Addition Agents upon the Conductivity, Cathodic Polarisation, and Grain Size of Deposits obtained from the Cell: $Cu/CuSO_4$, H_2SO_4/Cu.—S. Glasstone and E. B. Sanigar: The Electro-Deposition of Silver from Argentocyanide Solutions.

THURSDAY, DECEMBER 12.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: An Extension of Whipple's Theorem on Well-poised Hypergeometric Series.—Mary L. Cartwright: On the Maximum Modulus Principle for Functions with Zeros and Poles.—T. Estermann: On the Representation of a Number as the Sum of Two Products (Second Paper).—D. E. Littlewood: The Solution of Linear Congruences in Quaternions.—Prof. L. J. Mordell: On Hecke's Modular Functions and Some Other Analytic Functions in the Theory of Numbers.—L. Roth: Line Congruences in Three Dimensions.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. H. Freundlich: Surface Forces and Chemical Equilibria (Liversidge Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with British Section of Société des Ingénieurs Civils de France), at 6.—L. A. E. Sekutowicz and A. Evain: The Electrical Plant and Network of the Société Électrique de la Sidérurgie Lorraine.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. W. Rosenhain: The Development of Materials for Aircraft Purposes.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (at Bristol University), at 6.30.—S. Robson: The Treatment of Flotation Concentrates preparatory to Zinc Smelting.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. R. Douglas: What is expected of a Junior Engineer on joining his First Ship?

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—A. H. Mundey: Die-Casting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group: Informal Meeting), at 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates) (at Watergate House), at 7.25.—C. A. Partridge: Repairs.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institution of the Rubber Industry) (at Grand Hotel, Birmingham), at 7.30.—A. Healey: The Mechanical Properties of Rubber.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—A. F. Stevenson: Cable Design.

INSTITUTE OF METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7.30.—D. F. Campbell and W. S. Gifford: Metal Melting by Electricity.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch), at 7.30.—N. J. Lunan: Modern Constructional Steelwork.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—J. Guild: The Insensitivity and Personal Equation Errors of Optical Settings.—*Exhibits and Demonstrations:*—Adam Hilger, Ltd.: Cylindrical Mirror corrected to give Freedom from Aberration in the Formation of an Image of a Distant Line when the Angle of Incidence is 45°.—C. Brown: Duo Chrome Sight Test.—C. W. Dixey and Son: The Maddox Cheiroscope.

INSTITUTION OF WELDING ENGINEERS (at Caxton Hall), at 7.45.—L. W. Schuster: The Fusion Welding of Unfired Pressure Vessels (Lecture).

INSTITUTE OF PATENTEES (at Caxton Hall), at 8.—Sir William A. Lane, Bart.: Inventions as an Aid to Health.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Prof. Warrington Yorke: Blackwater Fever.

FRIDAY, DECEMBER 13.

BIOCHEMICAL SOCIETY (at St. Bartholomew's Hospital), at 3 P.M.—H. E. Archer and G. A. Harrison: The Effect of Reaction on the Heat Test for Bence-Jones' Proteinuria.—W. H. Hurtley: Notes on the Determination of Iodine in Blood, etc.—K. V. Thimann: The Precipitation of the Basic Amino-acids of Proteins by Phosphotungstic Acid.—M. J. Rowlands and B. Wilkinson: Vitamin Content of Grass Seeds in Relationship to Manures.—A. G. Norman: The Biological Decomposition of Plant Materials.—D. R. P. Murray and C. G. King: The Stereochemical Specificity of Esterases.—H. Chick and M. H. Roscoe: Stability to Heat of Vitamin B_2 (Anti-dermatitis, Anti-pellagra).—F. K. Herbert and M. C. Bourne: The Non-Glucose Reducing Substances of Blood, with Special Reference to Glutathione.—B. W. Town: Isolation of Isoleucine from Gliadin.—H. G. Reeves and E. T. Renborn: Some Properties of Dihydroxyacetone.—J. M. Gulland and R. A. Peters: Observations on the Reducing Substances in Avian Blood.—G. Graham: The Presence of Homogentisic Acid in the Blood of Patients with Alkaptonuria.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Brown: Observations of (Ch. 678) U Persei, 1924–29.—E. A. Kreiken: The Distribution of the Double Stars along the Giant Series.—J. G. Hagen: On the Significance of Baxendell's Nebulosity.—H. G. Tomkins: Three Features of the Lunar Crust, from Photographs taken at Dedham.—Dr. H. Spencer Jones and J. W. Jackson: Stellar Parallaxes Determined Photographically at the Cape Observatory (2nd list).—W. S. Franks: Visual Observations of Dark Nebulæ.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—J. H. Awbery and Dr. Ezer Griffiths: Apparatus for Determining the Specific Heat of a Material in Powder Form.—Dr. W. E. Deming: On the Determination of the Parameters in an Empirical Formula.—N. S. Alexander: The *J*-Phenomenon in X-Rays.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. G. F. Charnock: Bearings for Power Shafting.

TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—A. E. Woodhead: Commercial Application of the New Esterified Cotton Fibres.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Stern: Fastness to Light.—C. D. O. Winslade: Some Aspects of Colour Testing.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—E. Wilson and others: Is Sea Experience essential in order to become a Good Marine Engineer?

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Ernest W. Moir, Bart.: Some Engineering Difficulties and how they were overcome (Presidential Address).

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. J. Spurr: The Dyeing and Finishing of Hosiery Fabrics.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. F. C. Lea: Physical Testing.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND, at 8.—Dr. L. H. Lampitt: The Chemist and Commerce (S. M. Gluckstein Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Miss D. A. E. Garrod: Cave Excavation in the Near East.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at St. Thomas' Café, Swansea).—E. A. Tyler: Pure Chemicals.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (jointly with Manchester Literary and Philosophical Society: Chemical Section) (at Manchester).—C. Hollins: Patent Law in Relation to the Dyestuffs Industry.

SATURDAY, DECEMBER 14.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.

PHYSIOLOGICAL SOCIETY (at St. Thomas's Hospital).

PUBLIC LECTURES.

SATURDAY, DECEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Prof. H. Levy: Dimensional Theory as a School Subject (Presidential Address).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: British Wild Life off the Beaten Tracks.

MONDAY, DECEMBER 9.

LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers (4): Asia.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (Royal College of Science), at 5.30.—Dr. D. A. Allan: Rocks as Records of Earth History (Swiney Lectures). (Succeeding Lectures on Dec. 11, 13, 16, 18, 20, Jan. 20, 22, 24, 27, 29, 31.)

TUESDAY, DECEMBER 10.

TECHNICAL COLLEGE, CARDIFF, at 7.30.—Dr. J. H. Quastel: The Search for Drugs to cure Disease.

UNIVERSITY OF LEEDS, at 8.—Dr. J. S. Anderson: Infection.

WEDNESDAY, DECEMBER 11.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. Winifred Cullis: Speed as a Psycho-Physiological Factor in the Life of To-day.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—Prof. F. G. Parsons: The Anthropological History of the Modern Englishman.

SATURDAY, DECEMBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Witchcraft.

EXHIBITION, ETC.

DECEMBER 6.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (at Central Hall, Westminster).

10.30 A.M. to 12.30 P.M.—W. E. Schall: A Single Valve Plant for Diagnosis and Deep Therapy.—Cuthbert Andrews: A Mobile X-ray Unit.—Dr. Ffrangeon Roberts: Modern Radiological Developments in Germany with Special Reference to the New Institute at Frankfurt.—Dr. A. Orliansky: Output of Transformers under Different Methods of High Tension Rectification.—W. R. Gray: A Hot Cathode Tube with Rotating Anode.—Dr. E. J. H. Roth: The Mekapion, an Ionisation Apparatus for the Absolute Measurement of X-ray Dose.

At 2.30.—Miss S. F. Cox and F. G. Spear: Tissue Culture and its Application to Radiological Problems.—Miss S. F. Cox: The Action of X-rays on Living Cells Cultivated *in vitro*.—Dr. F. G. Spear: The Immediate and Delayed Effects of Radium on Tissues Cultivated *in vitro*.

CONFERENCE.

DECEMBER 6.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—Vapour Absorption and Adsorption.

At 10.30 A.M.—A. Hoch: The Recovery of Volatile Solvents (Brégeat Process).—J. S. Morgan: The Continuous Fractionation of Gases by Adsorbents.

At 2.30.—G. W. Himus: Evaporation of Water in Open Pans.—K. Evans and H. F. Pearson: The Industrial Application of Active Carbon.

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NATURE

SATURDAY, DECEMBER 14, 1929.

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The Museums Report and National Folk Museums.

IN the concluding paragraphs of Part 1 of the Final Report of the Royal Commission on National Museums and Collections,[1] some outstanding needs in the national museum service are indicated. In the order named there are: an ethnographical museum, a folk museum, an Oriental museum, and a museum of casts. This sequence is not without its significance.

While it may be admitted without question that the Commissioners, in giving first place to the need of an ethnographical museum, have emphasised an almost astounding neglect of opportunity, and what is more, of a duty in an imperial system such as that of Great Britain, they are equally justified in regarding the institution of a folk museum as coming second in importance on the ground of urgency. If it is desirable that a record should be preserved of the daily life of the people in the past—a matter about which there can scarcely be two opinions when once its full significance has been grasped—it is necessary that steps should be taken to give effect to the proposal as soon as possible. Indeed, it is no exaggeration to say that in all probability there is no question upon which the Report of the Commission has touched which calls more insistently for immediate action. Almost day by day it will become more difficult to bring together the material from which such a museum must be formed. The action of the Royal Society of Arts has stimulated public opinion to an interest in the preservation of typical or striking examples of domestic architecture of the humbler sort belonging to the past. But these efforts are limited by a variety of conditions and they are confined to one class of material only. Peasant industries carried on in the cottages and villages of the remoter districts, such as the lace-making and wood-turning of Buckinghamshire, even if artificially stimulated as some have been, are unlikely to survive for very long; articles of obsolescent use will be thrown aside for modern substitutes, and those which have been discarded but preserved by a generation which once used them will be cast out as rubbish when that generation dies out. Recent experience has shown that it is becoming increasingly difficult to find examples of objects which a few years ago were comparatively common in the countryside.

In making its recommendation, the Commission

[1] Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20 September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office, 1929.) 2s. net.

has very precisely in mind the type of museum which it would wish to see established. Not only is a museum illustrating the domestic life of the people in the past contemplated; it is also recommended that this should be of the type known as the open-air museum. The report refers to the museums of this kind which have been instituted in Scandinavia and in Holland. These museums, as is well known, consist of a number of typical dwellings of different periods which have been set up in a park, each fitted with the appropriate furniture, utensils, domestic appliances, and objects of peasant art of the period of the dwellings in which they are housed. At present there is nothing of this kind in existence in Britain, and it is recommended that ultimately there should be one each for England, Scotland, Wales, and Ireland, but it is stressed that for the moment the case of England is the most urgent. Herein the Commission does not go beyond the warrant of the facts. Conditions in Scotland, Wales, and Ireland are, and perhaps for some little time will continue to be, more favourable to the preservation of their distinctive peasant culture than they are in England, where local peculiarities are rapidly disappearing before modernising influences, and the population itself is rapidly losing the conservatism which still remains a characteristic of the people in the remoter parts of the rest of Britain.

The Report contemplates a museum which will illustrate the domestic life of the past; but it is clear that such a museum of the folk is capable of an almost indefinite expansion in regard to time, local character, and the nature of the exhibits. To take the last point first. The Commissioners would appear to have had something of the nature of this question in mind when they refer to the advantages of the situation of the open-air museum at Stockholm near the famous 'Northern Museum' which contains "an enormous collection of objects illustrating the history and development of the Swedish people". Now, as it is not probable that our museum will have a similar advantage, this suggests the question: Up to what point can the function of a folk museum be understood to be to illustrate the culture of the people as a whole, or, in other words, where in the social scale must the line of demarcation of 'the folk' be drawn? Does there not come a stage in the time series at which the collections run the risk of being merely of antiquarian interest and of losing much of their educational value as an index of culture if a hard-and-fast line separating the grades of society be laid down? As an example of a practical question that arises, the authorities of the National Museum at Cardiff have included in their folk museum galleries, costumes of the upper classes of the eighteenth century. Their local origin may be held to justify their inclusion there. In a national folk museum in England, their late date alone would determine their exclusion as other collections are available to receive them. Yet when it becomes necessary to adjudicate upon exhibits of an earlier date, which are less generally familiar, provided they are significant of the general level of culture and not of highly specialised character — military, ceremonial, or sumptuary — decision will become increasingly difficult.

An analogous question may arise in connexion with the selection of the buildings it is desired to re-erect to form the museum. Cottages, barns, and the like offer no difficulty, but the church and the manor house were equally an integral part of the life of the countryside, even if not intended for the occupation or sole use of the peasantry. Village crosses, boundary marks, milestones, and the like objects may also, it may be taken, come within the scope of our folk museum.

As regards exhibits distinctively local in character, it may be thought that it is evidently the function of the local museum in the first instance to ensure their preservation. On the other hand, it would be difficult to over-estimate the value to the anthropologist, the historian, and the geographer, of the inclusion of localised series exemplifying, for example, the culture of the Cotswolds, or of the Sussex area with its iron industry of uninterrupted pedigree, extending back to the early days of the working of that metal in England.

In the time series, it may perhaps be found equally difficult to draw the line of demarcation. The end of the Roman occupation affords a convenient starting-point. Yet settled life in Britain does not begin at that date, and if an attempt were made to complete the picture by reconstruction of dwellings and village sites for which there is evidence, there is no logical ground why a further step should not be taken and a lake-village or a hill-fort site, or even mounds and barrows, should not be reproduced.

It may seem that a consideration of these points at this juncture is irrelevant to the recommendation of the Report, which goes no further than to recommend the institution of an open-air museum illustrating the *domestic* life of the people in the past. But the Report has made no attempt to define the scope of such a museum, and it is as well to keep in mind the difficulty of avoiding the expansion of the museum into something much wider than merely

peasant art and industry, cottage utensils, appliances and ornaments, in their appropriate setting of time and space. Both from the educational and the scientific point of view, a museum of the history of our national culture of which the open-air museum formed a part would be the ideal. At present, however, if only on practical grounds and as emphasising the immediate and pressing need, a more restricted conception of the aims of a folk museum must be regarded as holding the field.

One reason, however, why it may be worth while to keep in view the widest interpretation of the folk museum is its relation to the choice of a site. The site should be such as to admit of expansion beyond immediate needs. The Report mentions two possibilities: one, the ground in Regent's Park at present occupied by the Royal Botanic Society, which it is said is to be vacant in 1932; and second, the grounds at Chiswick House, of which the extent is 66 acres. A possibility which has been put forward in the daily press, but is not mentioned in the Report, is the Forest of Dean. As regards the last named, most, we venture to think, will be in agreement with the Report when it says that the site should be in or near London. It is imperative, however suitable the site in other respects, that it should be readily accessible to the largest possible number of students and visitors. As regards space, it should have sufficient acreage to allow for the setting up of a number of peasants' dwelling-houses of various types and periods with gardens when appropriate, say at least ten acres, perhaps even twenty, and provision must be made for administrative offices and the exhibition of smaller objects, amulets, personal ornaments, and the like, which it would not be advisable to exhibit in the dwelling-houses.

It is obvious that such a site will not be easy to find in or near London. At Chiswick House both house and grounds have a marked individuality which does not lend itself to providing an environment adaptable to the character of peasants' cottages, even if the claims of the public under the agreement by which the property has been entrusted to the local authority permitted the cession of a sufficient area of land to the museum. Regent's Park is ideally central in position, and it is doubtful if a better site could be found; but being Crown land in one of London's great open spaces, the suggestion has been criticised on the ground that this land should no longer continue to be enclosed. If, however, the open-air museum were instituted as a part of our national collections and, therefore, open to the public, this objection would lose much of its force. On this aspect of the matter, however, the Report is anything but encouraging. It holds out little hope that the deficiencies to which it directs attention will be met from public funds. Here it again invokes the private benefactor.

An enterprise of the magnitude and importance of an open-air folk museum should undoubtedly be a national concern, but if present financial conditions preclude government action, is there any alternative? The institution of a folk museum is a question of which the urgency has long been apparent. It had been under the consideration of the Council of the Royal Anthropological Institute even before the appointment of the Royal Commission. A committee was formed, which has since been strengthened by the addition of representatives of scientific bodies most actively interested in this matter. A site alternative to those proposed in the Museums Report has been offered to the committee. It possesses many advantages and the price is low. But, clearly, no body of this character could enter upon an undertaking of such magnitude without the assurance of considerable public support, and only in the last resort when all efforts to secure the performance of an obvious public duty by the State had failed.

The Universe.

The Universe Around Us. By Sir James Jeans. Pp. x + 352 + 24 plates. (Cambridge: At the University Press, 1929.) 12*s.* 6*d.* net.

THIS book is an attempt to picture, in language which any intelligent reader can follow, the universe around us, from its greatest to its minutest features. Astronomy has undergone, in the last generation, a peaceful development which is greater than a revolution. It has become universal. The change of base from the solar system to the stars is a greater change than the change from the earth to the sun, and the consequences are not the less momentous because in this case the change has been made without conflict or opposition. That some such change must be taken, at some future time, has been obvious. In the past, guess and forecast have always fallen short of the facts, and in any case they are repugnant to those who value facts and see how the impressive scheme of astronomy has been built up by following the rule of never saying more than we know. But the means of gaining knowledge seemed wholly inadequate to cope with the question. There seemed no hope of getting a trustworthy outline in our time,

or in any other time that we could look forward to. But this is now changed.

The universe, however, must be described not only in terms of stars but also in terms of atoms. It extends like a series of numbers upwards to the very big and downwards to the very little. It extends forwards and backwards in time, as well as in space, and to gigantic as well as to minute intervals of time. We, who have to evolve a picture of this scheme, are literally a mere point, placed somewhere in the middle of it, with literal infinities extending before and after us, beneath us and above us, going out beyond the grasp, or even the intelligible conjecture of sense. Descartes conjectured that God might create the world anew every instant. It would save many difficulties if we could believe. Failing that explanation, we must first invent memory to carry us from instant to instant, and then rationalise its record, and extend it to history and prehistory, and even then, as a geometer would put it, we have only succeeded in drawing a tangent line, whereas our business is with the whole of the curve; and how are we to reach it?

The present book, as Sir James Jeans tells us, had its origin in some broadcast talks. It is an unsatisfactory origin, for the broadcaster, even more than the lecturer, cannot be confronted with what he said last, and is tempted to sharpen his points and exaggerate his emphasis in the effort to 'put it across' in the briefest time, to an unseen, unknown, and very numerous audience. So far as the origin can be traced in the book, it is nothing but a disadvantage, but it amounts to little. The early part of the book is perhaps a little disjointed and breathless. Those who know Jeans's other writings will notice with surprise another feature, an occasional careless phrase. A "celestial pepper pot" is, like the "beautified Ophelia", "an ill phrase, a vile phrase",—so is "opinion is rather in the melting pot". If Sir James Jeans has left these things in his pages, it is only because he could not be bothered to weed them out. That, in fact, is the note of the book, and gives it, in my judgment, some of its impressive force. The many passages of real and spontaneous eloquence in it gain rather than lose from standing side by side with such careless but efficient words. Some of the facts related are fairly familiar to scientific readers, but that could scarcely be avoided if the book is meant for all. The impression left is that of a man who, as we know, has ranged to and fro over the whole of mathematical physics, and has contributed a great deal in different places to the establishment and precision of its ideas, and who now tells us what he thinks of it all, without any catch-penny phrases, without any jokes, as the expression of an intense personal interest, which would be infectious in any case, but is much more so from the knowledge of the competence of the author.

It is worth while to see how it comes that a complete and convincing picture can now be given, answering all the main questions, over an area that seemed a little time ago far too extensive and remote to get any real knowledge of it. Take the scale and extent of the astronomical universe. The material contributed by the great American observatories, especially Mount Wilson, is striking. Nine out of ten of the beautiful plates that illustrate the volume are drawn from that source. Without them, much that is now clear would go unverified. The immense advantages conferred by the great telescopes and the Californian skies are evident.

Material resources, however, are not everything. No one, least of all the astronomers of that great observatory, would make such a claim. The very reason their efforts have been so well directed, and the material they have provided has been so well used, lies in the widespread interest that is felt for these problems in every part of the world, by which, wherever an alert mind was found, it contributed to putting a significant question, and then to threshing out the conclusions from the results that were furnished. Usually this has to be done several times over before people are satisfied. Replace America and Mount Wilson by England and Cambridge, and very much the same is true of the atom. Improved communications of all kinds have enormously increased the speed and efficiency, and cumulative power, of scientific investigation. The outcome as shown in this book is a description which offers answers to almost every physical question we want to put, and one which has been so closely criticised that we cannot believe it can be seriously shaken anywhere.

What, then, is the outcome? The infinitely great and the infinitely little are terms that have been used for a long time, and to speak in the vernacular, 'they didn't cut much ice'. The most remarkable feature of the new cosmogony is that it is queer. At both ends. It is as queer and unintelligible as life and morals have long since been voted, by those who have studied them. Many people have recognised from an early date that the quantum theory was really more disruptive of preconceived ideas than relativity itself. The more we look at it the more inevitable the fact is. We require to

keep two contradictory views in use at once. That does not baffle the theorists, who have brought in matrices, with their two different products as the norm, and reduced it all to calculation. But the price is that we must once and for ever abandon the guidance of our senses; and if this *is* ultimate reality, we do not know what it means, now that we have found it.

Scarcely less bewildering is the view in the cosmic field. We have long since known that the universe presented a spectacle of the degradation of energy. Now that we know, more or less, what the universe is, we see what that statement means. Cosmic rays, derived apparently from the mutual extinction of protons and electrons, are flying in great quantity in all directions. There are some millions of great nebulæ, the nearest so remote that its light takes nearly a million years to reach us. These great nebulæ are gradually collecting from the all-but-void, and each is degenerating into clusters of hundreds of thousands of stars. Each star lives on the extinction of its own matter. The sun, for example, loses four million tons a second ; and out of its year's output, a small fraction of one second represents what we happen to intercept and on which we keep going. The extent of the universe in time and the absence of any significant happening is just as remarkable. What is all this universe for ? Who wound it up ? When ? Why ? Vain questions. The universe did not exist for any of us a hundred years ago, and it will cease to exist in any physical sense even more briefly.

But if these are vain questions, it is far from a vain pursuit to write a book like the present one. Here is the physical outline of the world, and unless our intellect is totally misleading, it cannot be much wrong. Unless we are prepared to assert that it is, everything else must square with this frame. All current beliefs must be overhauled so that they may fit into the picture, and a great many of them, fundamental and otherwise, will suffer severely before the process is complete.

R. A. S.

Discovery and Invention.

A History of Mechanical Inventions. By Prof. A. P. Usher. Pp. xi+401. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1929.) 25*s.* net.

"THE history of the development of the inventive faculty", said Mason in his "Origin of Inventions", "is the history of humanity"; while the term invention, used in its plain logical sense, he added, may be applied not only to mechanical devices but also to the processes of life, languages, fine art, social structures and functions, philosophies, formulæ, creeds and cults, all of which involve over and over again the same activities of mind.

Though applicable to the whole range of human endeavour, by common usage invention is associated in our minds with tools, utensils, appliances, instruments, machines and engines, and we all think of the inventor as one who troubles himself with such things. Even with this restricted significance, the history of invention takes us back to the most remote age and into every corner of the world, and opens up as fascinating a study as can be found anywhere else and one that touches life on every side. Between the fashioning of the most primitive knives, needles, snares, weapons, rafts, and shelters, and our complex machinery, our powerful engines, our instruments of refinement and precision, lies the history of material civilisation.

In spite, however, of the interest and importance of the subject, there are few books dealing with it in a critical or general manner. Certain branches of invention have had their historians, and there are a few biographies of modern inventors and reviews of definite periods, but these do not meet the needs of the ordinary reader. It is with pleasure, therefore, we direct attention to Prof. Usher's series of sketches dealing not only with some of the most notable of mechanical inventions, but also with the place of technology in economic history and with the process of invention itself, a process in which the powers of imagination are fully employed. Dismissing the view that the process of innovation is a phenomenon more mysterious than other phases of our mental life, the author discusses the nature and theory of innovation, distinguishes between discovery and invention, and shows how the development of modern experimental science laid the foundation of our modern technology. Writing of the function of the fore-conscious mind in invention, he says :

> The inventor, like the artist, lives on the border land between the normal and the abnormal, and, like artists and prophets, finds in his day-dreams a source of gratification and encouragement at the least, and at times a fruitful source of genuine accomplishment.

The opening chapters are as fresh and stimulating as they are unusual in a book on invention, and it may be presumed that we owe Prof.

Usher's psychological studies to the fact that he writes as a professor of economics and not as a technician.

Of inventions themselves we are given chapters on the mechanical equipment of the pre-Christian era, on water wheels and wind mills, water clocks and other time-keepers, the invention of printing, the textile industries, and the production and application of power. Only one inventor has a chapter to himself, this exception being that remarkably versatile genius, Leonardo da Vinci. Famous as an artist and as constructor, there is certainly no ground for the view that his scientific and mechanical capacities were in any way inferior to his artistic powers.

Right throughout the book emphasis is placed on those inventions which, in Prof. Usher's words, exhibited primary synthesis rather than critical revision, and attention is directed to the innovations which led to notable and fundamental advances. The book is well illustrated; authorities are quoted; there is a valuable bibliography and a satisfactory index. It undoubtedly fills a gap in the list of English works on invention and should be valuable to many classes of readers, and especially to those engaged in teaching economic and industrial history.

Pharmaceutical Products.

(1) *Kraemer's Scientific and Applied Pharmacognosy.* Third edition, thoroughly revised by the following named Editorial Committee: Editor-in-Chief, Dr. Edwin L. Newcomb; Co-Editors, Prof. Leasure K. Darbaker, Prof. Earl B. Fischer, Prof. Edmund N. Gathercoal. Pp. xxxvii + 893. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 37*s.* 6*d.* net.

(2) *Handbook of Pharmacognosy.* By Dr. Otto A. Wall. Revised by Prof. Leo Suppan. Fifth edition. Pp. 472. (London: Henry Kimpton, 1928.) 21*s.* net.

(1) DURING the past few years the study of crude drugs derived from the vegetable and animal kingdoms has attracted an ever-increasing amount of attention, and the interest in this branch of knowledge has shown a remarkable revival. Medicinal plant farms, where the changes effected in the constituents of medicinal plants grown under varying conditions can be studied, have been established in increasing number. In that respect Great Britain has shown a tendency to lag behind, due probably to a lack of that public support which is freely given on the Continent. Striking evidence of the interest taken in this subject abroad is shown by the success attending the conferences recently held in Budapest and in Venice by the international association for the promotion of the production of medicinal plants. The authors of "Kraemer's Pharmacognosy" have every justification for the statement they make in the preface that "pharmacognosy must play an increasingly important part in the future of pharmacy and medicine".

Pharmacognosy now involves so much botany, chemistry, pharmacology, and other sciences, that the decision to entrust the revision of the third edition to an editorial board of four members must be regarded as justified. The general plan of the work has been retained, but about fifteen new monographs have been introduced and the size of the volume increased by about 130 pages. The number of drugs discussed is therefore very large; in fact, it might safely be said that the work contains information upon most drugs of importance.

There are numerous illustrations of varying quality, many being good and some indifferent, while in other cases it is rather difficult to find a reason for their introduction.

Organotherapy, vaccine therapy, serum therapy, and protein therapy have of late made notable additions to the armamentarium of the physician, and of these pharmacognosy must take cognisance. Accordingly, the book contains brief allusions to vaccines, sera, etc., and also an account of the collection of pollen for diagnostic and curative use. Under the heading "Animal Drugs" the editorial board says, "Their study is much neglected by students of pharmacy, and more attention should be given them as they furnish some of the most important drugs used by man". In view of this statement, it is rather remarkable that the only animal drugs discussed in the book are cantharides, cochineal, musk, and civet. One would have expected to find descriptions of the thyroid and pituitary glands, which are official in the U.S. Pharmacopœia, of the suprarenal glands, of the pancreas and others, but nothing beyond a mere mention of them in the course of half a dozen lines is to be found. Nor is there any mention of such animal products as cod-liver oil, spermaceti, beeswax, or woolfat.

Possibly these substances were regarded by the editorial board as outside the scope of pharmacognosy, but it is not easy to ascertain whether this is really the case. On page xlv the following state-

ients are to be found: "Pharmacognosy is ssentially the study of organic drugs and allied roducts"; "In a more restricted sense pharmaognosy embraces the study of medicinal plants nd their crude products"; "in short, pharmaognosy deals with the properties, identification, ources, and nature of new materials and their roducts"; "the ultimate aim of the science of pharmacognosy is to obtain a knowledge of the hemical nature and the properties of all commercial roducts from their origin in nature to the final hanges produced in their manufacture". What, hen, *does* the editorial board really understand by pharmacognosy?

A careful examination of the accounts of at least the more important drugs reveals deficiencies and inaccuracies that should not occur in a work of this description. The collection of acacia gum and of benzoin, for example, leaves much to be desired; the constituents of benzoin and of ammoniacum do not correspond with the results of recent investigation; cathartic acid still occurs as one of the three active constituents of senna, and so on. Had the authors been acquainted with the thorough examination of santonica made by Wallis and Mowat, they would probably have modified their account of it, but it is remarkable that reference to an English literary source of information is rarely to be found.

The work is one of the best known and probably one of the best of American text-books of pharmacognosy. It contains abundant information, but it would appear that in preparing the present edition sufficient care was not given to revising the text, correcting inaccuracies, introducing the results of recent researches, and generally bringing the work abreast of the progress of pharmacognosy.

(2) This work was originally written to serve as notes in pharmacognosy for students in colleges of pharmacy, in order to relieve them from the labour of taking notes and leave them free to follow the information and explanations given by the lecturer. It would afford, therefore, a skeleton to be clothed later with muscle by the student himself in the course of his post-graduate study. Such a method of dealing with pharmacognosy is by no means new, and while it appears at the first glance to possess advantages, it suffers from the danger that the student may neglect to provide the muscles for the skeleton and content himself with a collection of dry bones, relying chiefly upon his memory instead of upon his understanding.

As the book has now reached its fifth edition and Prof. Suppan has retained this method of dealing with the subject, it must be assumed that the object in view has been attained and that the student has been provided with and uses a condensed outline of pharmacognosy which he can afterwards amplify as opportunity offers. A student seldom makes satisfactory progress in a subject in which he is not interested, and whether this method of presenting it will attract and interest him and stimulate him to further independent inquiry is to be doubted; probably it will not. The information, though given in a very condensed form, is on the whole fairly accurate. Errors are to be found, as indeed they are to be found in all books, but as a rule they are of minor importance.

Numerous illustrations accompany the text and serve their purpose, although some of them lack artistic finish. It is doubtful whether the book will meet with a ready outlet in Great Britain. It is not suited for class work for English students, and is not sufficiently thorough or detailed to be useful as a work of reference.

A "Handbuch" of Zoology.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Band 2: *Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida.* Lieferung 1, Teil 1. Pp. 112. 12 gold marks. Lieferung 2, Teil 8. Pp. 112. 12 gold marks. Lieferung 3, Teil 2. Pp. 128. 14 gold marks. Lieferung 4, Teile 3 und 4. Pp. 110+18. 14 gold marks. Lieferung 5, Teil 4. Pp. 19-146. 14 gold marks. Band 4: *Progoneata, Chilopoda, Insecta.* Lieferung 6. Pp. 577-672. 10 gold marks. Lieferung 7. Pp. 673-800. 14 gold marks. Band 6: *Acrania (Cephalochorda), Cyclostoma, Ichthya, Amphibia.* Hälfte 1, Lieferung 1. Pp. 112. 12 gold marks. Band 7: *Sauropsida, Reptilia, Aves.* Hälfte 2, Lieferung 3. Pp. 225-336. 12 gold marks. Lieferung 4. Pp. 337-432. 10 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1928.)

SINCE our last reference to this fine "Handbuch", ten parts—1056 pp.—have reached us, and it may be said at once that they fully maintain the standard of the earlier parts both in text and illustrations.

The second volume on a portion of the Vermes is to consist of nine independent parts, five of which have been published during the last twelve months. In this volume the accounts of the Amera—the

flatworms and roundworms—and the Polymera, that is, the Annelida, including the Echiurida, Sipunculida, and Priapulida, will find a place. The description of the Myzostomida has appeared in the first half of the third volume, and the Oligomera—Phoronis, Bryozoa, Brachiopoda, Chætognatha, Rhabdopleura, Cephalodiscus, and Enteropneusta—are to be considered in the second half of that volume. A brief general introduction to the Amera is given in Bd. 2, Lief. 1, Teil 1, by Dr. E. Reisinger, who, in a paragraph on the phylogeny, derives the Gastrotricha and therewith all Nemathelminthes from the Platyhelminthes, particularly the Rhabdocœl Turbellaria. A definition and short consideration of the morphology, development, and phylogeny of the Platyhelminthes are given by Prof. E. Bresslau and Dr. Reisinger, who set aside the theory of the relationship of Ctenophores and Polyclads. They regard the similarities exhibited by the Platyctenidæ and the Polyclads as due to convergence and they consider the Acœla to be the most primitive flatworms. Prof. Bresslau then proceeds to the detailed description (unfinished) of the anatomy and finer structure of the Turbellaria, the alimentary and nervous systems being well described with the help of many excellent figures, the majority of which are from recent memoirs.

Part 8 of the second section of this volume contains a compact account in 112 pages of the Oligochæta by Prof. W. Michaelsen, who has himself added so greatly to our knowledge of this class. His account of the finer structure of the nervous system is, however, disappointing—it gives no idea of the nature and relations of the neurones, and there is no satisfactory description or figure of the funnel of the nephridium of *Lumbricus*. But for much of the anatomy, and for distribution and ecology, and features used in classification, the account is excellent.

In part 2 of the third section, Prof. Otto Fuhrmann deals with the Trematoda—first with the Monogenea (pp. 29), and then with the Digenea, the account of which is unfinished. The text is supported by 171 well-drawn figures illustrating the anatomy and development of a representative series of examples.

Prof. L. Böhmig, in parts 3 and 4 of the fourth section, gives a good account of the structure, physiology, development, classification, and relationships of Nemertines. A figure showing the anatomy of *Malacobdella* would have been useful here. Following is a brief introduction to the Nemathelminthes, which are defined as including the Nematoda, Nematomorpha, and Acanthocephala, and also the Rotatoria, Gastrotricha, and Echinoderida. Dr. Wesenberg Lund's account of the Rotifera begins in this part and occupies the greater part of part 4 of section 5—altogether 120 pages—and, as would be expected from this author, such aspects of the subject as sexual and seasonal dimorphism, the life-cycle and the duration of life, and ecology receive full consideration. Dr. A. Remane's account (unfinished) of the Gastrotricha follows.

In sections 6 and 7 of the fourth volume is the first part of the account of the insects—the Apterygota and the lower Pterygota—by Dr. A. Handlirsch. Ample space is devoted to external features, dimorphism, larvæ and nymphs, fossil representatives, phylogeny, habits, ecology, distribution, and classification, but much more information might have been given on internal anatomy, and in some cases on physiology; scarcely any reference is made, moreover, to the finer structure (histology).

The account of *Amphioxus* (unfinished) by Dr. V. Pietschmann (Bd. 6, Hälfte 1, Lief. 1) includes an excellent description of the anatomy and histology, especially of the nervous system and sense organs. The account of the development is illustrated almost entirely by Hatschek's figures (with the polar mesoderm cells); it would have been well to include some from later investigators. The description and figures of the metamorphosis are inadequate.

In the seventh volume (Hälfte 2, Lief. 3, 4) Dr. E. Stresemann continues his account of the birds, describing the urinogenital system, sperm and ovum, development, hatching, the nestling and its down, the flight feathers, sexual dimorphism, differences in structure between the two sexes, and gynandromorphs. Beginning with the primary germ cells and their migration into the splanchnopleure, the history of the gonad in the embryo in both sexes is traced, and the seasonal changes of the adult gonads are noted. The section on development is relatively short, the author perhaps considering that, in view of Lillie's masterly volume on the subject, brief treatment was permissible. Nests, eggs, social life, parasitism—the case of the cuckoo and others—receive very adequate consideration, and the majority of the illustrations are from recent works and form an excellent support to the text.

The publishers deserve the support and encouragement of all zoologists for their enterprise in producing this comprehensive and valuable "Handbuch".

Our Bookshelf.

Biological Principles : a Critical Study. By J. H. Woodger. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xii + 498. (London : Kegan Paul and Co. ; New York : Harcourt, Brace and Co., 1929.) 21*s.* net.

No doubt most thoughtful biologists deplore the small number of generalisations which exist in their science compared with the ever-increasing masses of unrelated facts reported by workers in field and laboratory. Evidently some attention to fundamental concepts is required, and Mr. Woodger has made an attempt to survey critically the primary suppositions which are involved in biological thought. His book begins with a discussion of the relations between natural science and philosophy, including a vigorous attack upon phenomenalism. Mr. Woodger is for the most part a follower of Prof. Whitehead and the Cambridge school of logicians. The book then gives an account of the principal antitheses of biology (vitalism-mechanism, structure-function, organism-environment, preformation-epigenesis, teleology-causation, mind-body), mediating between them and mitigating the bitterness of their opposition. Finally, the author ventures on a discussion of the future of biology.

Mr. Woodger's very difficult task has been accomplished so successfully that no biologist who really wishes to face fundamental problems should omit to read it. Yet it suffers from three defects : (*a*) it is unnecessarily long, because unnecessarily polemic, especially against text-book statements ; (*b*) it attributes to physiologists, biochemists, and others with whom the author is not in sympathy, opinions much cruder than those they actually hold ; and (*c*) it is insufficiently constructive. Mr. Woodger tends to destroy without replacing. Thus on p. 315 he says, " It will be necessary to devise ways and means for correcting a purely analytical procedure ", but there the question is left, though most biologists would agree as to the importance of the way the parts are related ; the difficulty is to investigate without destroying. Perhaps Mr. Woodger will some day give us a better, shorter, more constructive book, suggesting methods of research better than those now in use, instead of simply pointing out their deficiencies.

The Soul of Manchester. Edited by Dr. W. H. Brindley. (Published for the Manchester Section of the Society of Chemical Industry.) Pp. xi + 280 + 16 plates. (Manchester : Manchester University Press, 1929.) 6*s.* net.

THIS interesting compilation, finely illustrated, commemorates the meeting of the Manchester Section of the Society of Chemical Industry, held in the city this year, and is very welcome. It is in no sense a guide-book, but a critical valuation of the activities—scientific, literary, educational, industrial, and general—of a centre which has long played a conspicuous part, for good and all, in the evolution of human affairs within and outside its borders. Authorities such as Sir Henry Miers, Prof. A. Lapworth, Prof. C. H. Herford, Sir Michael Sadler, Prof. F. E. Weiss, Prof. C. H. Reilly, Dr. Henry Guppy, and others recount success, failures, and future aspirations.

The attractiveness of citizenship lies, doubtless, in its fundamental diverseness. We would like to be told, in similar vein, of the soul of Liverpool, of Sheffield, Birmingham, Bristol, but realise the civic hardihood involved in such ventures. As for London, she must ever stand alone, mother of our cities, in spirit dominant.

The title of the book is fully met in able articles. These include : " The Story of Education ", " The Face of Manchester ", " Chemistry and Manchester University ", " Manchester and Cotton ", " Social Service ", " Manchester and Recreation ". An informing contribution, " Manchester and its Press ", recalls Alex. Ireland, sometime manager of the defunct *Examiner*, who came to Manchester from Edinburgh, where he had been associated with William and Robert Chambers. He was the only man in the country, we are told, in the secret of the authorship of " The Vestiges of Creation ".

Evolution by Symbiosis. By H. Reinheimer. Pp. viii + 141. (Surbiton : Grevett and Co., Ltd., 1928.) 5*s.* net.

IT is not very easy to deal with Mr. Reinheimer in a short notice ; but at the same time one cannot feel sure that he deserves a longer one. This book is but one of a number which he has written, all telling the same story, namely, " that the standards of virtue and vice in the universe depend upon two antitheses : symbiosis and parasitism ; that it is definitely immoral and ruinous, through the whole of nature, for an organism to be parasitic ; that the degree of virtue is the degree in which an organism co-operates or 'gets on' with the universe, living by helping the rest of creation " (p. 8). " Only austerely constituted organisms can hope to enjoy natural immunity from disease " (p. 23). A carnivore is a " semi-degenerate organism " (p. 44) ; " there is but a difference of degree between carnivorism and parasitism " (p. 45) ; " symbiotic cross-feeders [that is, herbivores] are *ipso facto* in due relation with the world of life and thereby best qualified to enter into fruitful, sympathetic and intelligent social intercourse of the most varied kinds " (p. 56), so long as they do not overdo it and become " plant-assassins " (wasteful and destructive herbivores) like the elephant, which is " a typical acromegalic animal in a state of hopeless senescence verging on extinction " (p. 109).

Mr. Reinheimer has produced a great bulk of argument in favour of his views, and it must be admitted that some of his ideas are clearly important, whilst others are at least interesting ; for example, a study of animal nutrition is obviously a necessary part of any comprehensive study of evolution. But Mr. Reinheimer spoils his own case by being peevish with biologists who do not accept his views. " Orthodox biology is written, as I have often said, to suit the perverted digestion of modern society " (p. 51). He has a favourite phrase, " as

I have often shown" ; our objection is that he has *not* shown ; we should be more grateful to him for a single piece of detailed original research bearing on the question of evolution, such as Heslop Harrison's work on the inheritance of melanic varieties in certain Lepidoptera, than for any amount of argument.

Researches in Polynesia and Melanesia ; an Account of Investigations in Samoa, Tonga, the Ellice Group, and the Hebrides, in 1924, 1925. By Patrick A. Buxton. Parts 5-7 (relating to Human Diseases and Welfare). (Memoir Series, No. 2.) Pp. xi + 139 + 27 plates. (London : London School of Hygiene and Tropical Diseases, 1928.) 9*s*.

FEW problems of tropical medicine are more complex than that of the pathology of filariasis ; it is one which for elucidation will require extensive research, carefully planned and properly standardised. Dr. Buxton's contribution to the problem forms Part 5 of the account of the investigations in Polynesia and Melanesia undertaken by the expedition sent out by the London School of Tropical Medicine. It bears the stamp of strictly scientific medical research. The methods and technique adopted are described in minute detail ; statistics are complete and precise ; a well-reasoned commentary concludes the account, and numerous references and cross-references enable the reader to verify readily the evidence on which the author's deductions are based. Considering the conditions under which research work in Oceania is carried out, Dr. Buxton is to be congratulated on the complete and exact nature of this record.

The study in filariasis forms the principal part of the book. Parts 6 and 7 are devoted to a consideration of other human diseases in Oceania, and the effect of European culture on the Samoan. The text is illustrated by a series of excellent photographs.

The Mind of the Savage. By Raoul Allier. Translated by Fred Rothwell. Pp. xiv + 301. (London : G. Bell and Sons, Ltd., 1929.) 15*s*. net.

THIS is the translation of a book which appeared first in 1927 under the title "Le non-civilisé et nous". The author, during a long life devoted to the study of Protestant theology in the University of Paris, has been closely associated with missionary work, especially in Madagascar. His study of the psychology and sociology of primitive peoples, which has proceeded concurrently with his activity in the administration of missions, has therefore had a strong practical bias throughout, which appears, as the original title shows, in this exposition of his conception of primitive mentality. The main line of his argument is aimed at demonstrating the disastrous and paralysing effect of the belief in magic in all departments of primitive life and activity. One point he brings out of which perhaps too little has been made hitherto, and that is that magic involves not so much the association of ideas as the association of emotions. He ranges himself with Lévy Bruhl and other French psychologists as against the English school. To some at least of the latter school his conclusions will appear too abstract and 'to smell of the lamp'. In other words, his view of the function of magic is external and ignores recent work which has studied it as an integral element functioning in a given social environment. The concluding chapters are practical in their bearing and deal with "A New Philosophy of Colonisation" and the rôle of Christian missions.

Trout Fisheries : their Care and Preservation. By J. C. Mottram. Pp. 186. (London : Herbert Jenkins, Ltd., 1928.) 10*s*. 6*d*. net.

To have the fortune to own or lease trout streams of the first order is the lot of few, and reading Mr. Mottram's book causes one to wish for some such water on which to experiment. Certainly, those who have this good fortune should not fail to study this work, which contains much practical advice ; it should also be in the hands of those who control the many associations which maintain the fisheries of the streams and lakes with which the British Isles abound.

Of special interest is the chapter on trout disease and restocking, in which the author directs attention to recent research on the causes of outbreaks of disease in large populations and the dangers of introducing healthy stock into populations which have already passed through an epidemic, thus incurring the risk of starting the disease afresh owing to the weak resistance of the new blood. The dangers of introducing possible carriers of furunculosis are also stressed, a subject the study of which has recently been taken up by a joint committee under the auspices of the Fishery Board for Scotland, the Ministry of Agriculture and Fisheries, and the Kennet Valley Fisheries Association,

The book is very clearly printed with large type and makes pleasant reading. The insertion of photographs to supplement some of the line diagrams would perhaps have been an improvement.

Medical Adventure : some Experiences of a General Practitioner. By Dr. Ernest Ward. Pp. xii + 291. (London : John Bale, Sons and Danielsson, Ltd., 1929.) 8*s*. 6*d*. net.

THE enjoyment with which many readers of the *London Hospital Gazette* have perused Dr. Ernest Ward's articles will be shared by all who read his book "Medical Adventure". Written with a literary ability rarely found in medical men, every chapter reveals the author's powers of observing and recording, and, when in lighter vein, his keen sense of humour. His accounts of difficult and amusing situations, of cases common and uncommon, of successes and failures, give a really unique description of a general practitioner's work. His reflections on many problems are most instructive, but are offered with unassuming modesty. To the young practitioner especially this book will prove of great value ; from it he will learn lessons as readily as if he had himself experienced Dr. Ward's adventures.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Severe Environmental Mortality among *Abra* (= *Syndosmya*) *alba*, *Donax vittatus*, and other Organisms off the Lancashire Coast.

WHILST walking along the Birkdale sands from Ainsdale to Southport on the Lancashire coast on Nov. 3, I noticed that immense numbers of small molluscs had recently been washed ashore, and as definite observations on environmental mortality are important in connexion with the adaptations of a species to its environment, such occurrences are worthy of record.

The spring tide had begun to ebb as I set out to walk from Ainsdale to Southport along the high-water mark at midday, and my attention was at once attracted by large numbers of tubes of *Pectinaria* and *Lanice* (=*Terebella*) and shells of *Abra alba* (=*Syndosmya*) Wood. The tubes of *Pectinaria* were empty, while those of *Lanice* constituted only the upper portion and, though obviously fresh, like those of *Pectinaria*, were also empty. These tubes occurred along the whole stretch of the sands examined, either in rows or piles, at and near the high-water mark, and the mortality in *Pectinaria* may be estimated to have been of the order calculated for *Abra* below. Probably no or little mortality occurred in *Lanice* owing to the habit of this animal of retreating down its deeply embedded tube at a rapid rate when disturbed. *Pectinaria*, having a cone-shaped tube, cannot retreat in this way and must perforce become exposed when its tube is washed out of the substratum.

Shells of *Abra* were also distributed along the whole of the region of the high-water line from Ainsdale to Southport, either in heaps in stream-lines or in crowded rows along the high-water mark or scattered over a strip of high-water wash-mark varying from about 5 to 10 yards mostly, according to the contour of the high-water region. The shells were entire and fresh, and on the return journey from Southport to Ainsdale it was estimated that from 25 to 50 per cent of them contained either living or recently dead tissue. A sample of the shells with soft parts remaining was examined in the laboratory on the same and following days, when living tissues were found. Living Trematode larvæ were also found in seven or eight individuals out of about 12 or 13 examined, one individual being heavily infected. There can be no doubt, therefore, that the *Abra* as well as the *Pectinaria* and *Lanice* had been washed ashore during a few recent (and spring) tides.

An attempt was made to estimate the number of *Abra* present on the strip of shore examined. In representative areas where the shells were scattered thinly, two counts in about a square foot gave about one in 10 sq. inches. In thicker collections at a typical place at the higher water-line there were about three per 10 sq. inches. In still thicker concentrations of common occurrence there were 20 in 10 sq. inches, and in a typical stream-line collection, of which there were abundance, 25 occurred in 10 sq. inches. Still thicker concentrations occurred where heaps of *Abra*, *Pectinaria*, and *Lanice* occurred to a depth of one to two inches or possibly deeper, but sometimes these heavier concentrations coincided with a sparsely besprinkled high-water zone. On the minimum estimate of a thickness of 14 *Abra* per square foot for a width of only 7½ yards along the high-tide zone from Ainsdale to Southport (fully three miles were carefully examined), it is easy to estimate that approximately 5 million individuals had been recently washed ashore on this strip of coast. But as shells were also found lower down in the tidal zone, and fishes, gulls, and other animals had in all probability fed on them, in addition to the thicker concentrations observed, it is probable that a more likely minimum estimation of the loss would be of the order of 10 million.

While counting the *Abra* it was observed that countless numbers of the spat of *Donax vittatus* (for the identification of which I am greatly indebted to my friend, Mr. R. Winckworth) occurred also along the high-water line, especially in stranded waves of froth. These also occurred with few exceptions along the greater part of the three miles of shore examined. At some points the spat were scattered over the high-water zone, but close observation was required to detect them, as their size ranged from only about 3 mm. to 4·3 mm. No attempt was made to estimate numbers in the heaped-up masses, but 58 were picked up on a halfpenny where they were lying about one deep. In many places masses of them could be picked up in one's fingers. The loss of the spat of *Donax vittatus* may therefore be estimated conservatively as ten times greater than that of *Abra*, and therefore of the order of 100 million on this strip of coast.

As some food-fishes, for example, plaice, devour *Abra*, *Donax*, and *Pectinaria* (see the work of Todd, Petersen, Ford, Ray, and others), the mortality observed represents perhaps a not unimportant loss of potential fish-food, and demonstrates in the case of *Donax* the manner in which the whole spatfall may fail in certain years even after the critical post-larval stage is overcome.

It seems probable that the mortality was due in this case to a certain wave-action set up by a combination of strong inshore winds coincident with spring tides, whereby is produced a strong ground-swell which washes out all organisms in the surface layers of the sandy or muddy sea-bottom. It would appear that this section of the coast is peculiarly liable to disturbance of this kind, as Chaster records immense quantities of the relatively large spiny cockle (*Cardium echinatum*) thrown up alive on the same beach in January 1891 (*Southport Soc. Nat. Hist.*, i. 1892).

J. H. ORTON.
The University,
Liverpool, Nov. 23.

Mechanism in Nerve Centres.

MACCURDY, in his stimulating book, "Common Principles in Psychology and Physiology", has assailed the mechanistic interpretation of reflex function as incompatible with known facts. He concedes that the nerve impulse, as exhibited in the peripheral nerve fibre, may be explicable on a physical basis, but he insists that as soon as we encounter the function of the nerve centre, even as exemplified in the simplest reflex arc, we are forced to recognise the presence of something quite apart from any physical mechanism. He contends that the nerve centre does not merely conduct impulses (as does the nerve fibre) but produces them. MacCurdy further objects to the assumption of physical mechanism in the nerve centre on three specific grounds; namely, a machine "cannot change itself or its functions to meet new conditions; it does not improve its performance with practice; it cannot perform some particular function depending originally on one part, after that part is destroyed".

Much has been written on the differences between conduction in the peripheral nerve fibre and in the

reflex arc which involves the grey matter of the spinal cord or brain (Sherrington, 1906; Forbes, 1929). The most salient differences are those of modification and variability; modification in that the end effect in the reflex corresponds less closely to the initiating stimulus than is the case with the direct excitation of peripheral nerve, for example, when the reflex response is characterised by prolonged after-discharge or by inhibition; variability in that the character of the reflex response is more dependent on blood supply and oxygen, and more subject to change under the influence of drugs or poisons. Yet in the case of both reflex arc and peripheral nerve, the ability to yield a functional response to an external stimulus depends on the existence of an unbroken conducting path of excitable protoplasm.

It is not clear to the physiologist why, if the principle of mechanism be admitted in the case of the nerve fibre, it should be denied the more delicate, but no less material structures in the nerve centre where the fibres branch and form an intricate network of intermingling ramifications.

Let us consider the several objections to a physical interpretation of reflex function. First, the contention that a physical mechanism cannot produce impulses may be answered in various ways. A telephone system may be likened to the nervous system, the inert wires resembling the peripheral nerve fibres, and the central exchange corresponding to the nerve centre. The switching of the incoming call to the proper line has until recently required a conscious operator, but now this function is performed by machine switching (widely used in America), an intricate mechanism without consciousness. A simpler case, and one perhaps resembling more closely the mechanism in the nervous system, would be a junctional point where fire, approaching along a train of gunpowder, initiates several fires in branching trains of powder. There would be no essential difference between the simple train and the branching train of powder, except in the mere fact of branching. The extensive spread of reflex effects evoked by stimulation of a single sensory nerve need not demand any more vitalistic explanation than such a branching of the conducting paths. Even the spontaneous initiation of impulses by the respiratory centre has a physical counterpart in the spontaneous, rhythmic disturbance on the surface of an iron wire immersed in nitric acid, described by Lillie (1928).

The second point is the contention that a machine cannot change its function to meet new conditions. This is met by reference to the toy beetle which walks to the edge of a table and, finding itself unable to go farther in that direction without falling off, turns and continues its exploration on another course. A more practical, if less spectacular, example is found in the stabiliser of an aeroplane, which automatically causes the plane to resume level flight when its course has been altered by a gust or 'air pocket'.

The contention that a machine cannot improve its performance with practice is at once refuted by the familiar fact that a new automobile improves in the performance of its function during the first 500 miles travelled.

As to the last contention, relating to the replacement of damaged parts, an ingenious mechanic might devise a number of ways in which a machine could be made to change automatically from one mode of operation to another in consequence of the failure of some of its parts; for example, a steam pipe might be provided with an automatic valve which, if the pipe burst, would divert the steam through another pipe. Electrical devices which perform essentially this function are actually in use in electric railways.

Hull and Baernstein (1929) have described a mechanism made of polarisable cells and thermal regulators, which imitates a dozen different functions characteristic of the central nervous system. Indeed, if we grant to the evolutionary process in Nature but a small fraction of the ingenuity proved by the demonstrable facts of anatomical arrangement, we shall grant ample possibilities for the use of physical method in the attainment of reflex function.

The attempt to find a point at which the activity of the nervous system breaks away from physical law is due to the desire for a solution of the conflict between determinism, toward which physiology tends, and free will, which the testimony of our subjective experience leads us to accept. Any attempt to escape from the dilemma by postulating a non-physical function in the synapse or reflex junctional point, is temporising and inadequate as a solution of the central riddle of philosophy; the postulate is arbitrary and, as is shown above, is not at all demanded by the nature of reflex function. Indeed, there is no good reason to suppose that the function of any part of the nervous system, viewed as a series of physical events, should be assumed to depart in any way from physical law (cf. Forbes, 1929). That which defies physical understanding is the arrangement and integration whereby the physical events become the vehicle of those elements in subjective life to which physical interpretation in itself offers no clue.

ALEXANDER FORBES.

Laboratories of Physiology,
Harvard Medical School.

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The Energetic Efficiency of Photosynthesis.

IN a recent paper (*Proc. Roy. Soc.*, B, **105**, p. 1) G. E. Briggs discusses critically the determination of the radiant energy which is actually absorbed by the chloroplast pigments of the living cell. He considers that my own researches (*Ann. de Physiol.*, t. 1, p. 47; 1925) upon this subject do not provide accurate data for the determination of the relative efficiency in different parts of the visible spectrum, and that for three reasons:

(1) Because the filters used transmitted an undetermined amount of infra-red radiation.

(2) Because the calculation of energy absorbed lacks a satisfactory basis.

(3) Because the efficiency may have been limited by the rate of supply of carbon dioxide.

In a later work (*Jour. de Physique*, t. 7, p. 33; 1926), which would seem to have escaped Dr. Briggs's attention, upon this subject, I have shown that these objections are unfounded. In this research the following points were established:

(1) When the layer of water before the filter was largely increased (to 50 cm. instead of 4 cm.) in order to limit the amount of infra-red radiation, the efficiency is only very slightly altered.

(2) It is possible to calculate exactly the fraction of the radiant energy actually absorbed by a thin thallus of *Ulva*. The expression for the absorbing power deduced theoretically by Langevin and experimentally verified by me, for a thin layer of material which absorbs a part of the radiation and diffuses another part, is

$$a = \frac{2}{1 + \sqrt{1 + \frac{K'}{K}} \coth \frac{\mu l}{2}}, \quad . \quad . \quad (1)$$

where K is the absorption coefficient and K' the

diffusion coefficient of the material, $\mu = \sqrt{K(K+K')}$, and l is the thickness of the layer. This expression, for the case of *Ulva*, as appears on developing it in series, gives values agreeing within two per cent with those calculated from the relation

$$a = 1 - \frac{\left(\frac{I_1}{I_0}\right)_v}{\left(\frac{I_1}{I_0}\right)_d}, \quad . \quad . \quad . \quad (2)$$

where $(I_1/I_0)_v$ is the transmission ratio by the green thallus, $(I_1/I_0)_d$ the same ratio for the decolorised thallus, I_0 being the incident intensity, I_1 the transmitted intensity.

Incidentally, it is to be noted that owing to the thinness of the *Ulva* used in my experiments $(I_1/I_0)_d$ is nearly unity; hence the expression

$$a = \left[1 - \left(\frac{I_1}{I_0}\right)v\right]\left[1 - \frac{\log\left(\frac{I_0}{I_1}\right)_d}{\log\left(\frac{I_0}{I_1}\right)_v}\right] \quad . \quad (3)$$

deduced on the assumption that the living cell behaves as a homogeneous mixture of two substances which both absorb the light, gives a value not very different from the value calculated from equation (2). It is easy to show that the discrepancy in the most unfavourable conditions, when the *Ulva* is not very thin, attains ten per cent, and the discrepancy of the ratio of absorbing powers for two regions (red and green) of the spectrum four per cent.

The formulæ do not agree in the case of a green leaf. The essential reason for their agreement in the case of *Ulva* is the thinness of the thallus, but the values of the average absorbing power in different spectral regions also serve to reduce the discrepancies.

(3) The intensity of the radiation in my experiments was very low, nearly 10^{-3} cal./min. cm.^{2}. The carbon dioxide content of the sea water was nearly 10^{-5} mol per litre; and, in so far as it is permissible to compare *Ulva* and *Chlorella*, it results from Warburg's work that at this concentration of carbon dioxide, the rate of supply of carbon dioxide does not limit the rate of photosynthesis. As appears from the published data, the concentration of carbon dioxide remaining after irradiation was either the same (respiration exactly compensating for assimilation) or decreased to a minute extent.

In conclusion, it will be apparent from what has been said that Briggs's criticism of my experiments is completely unjustified. With regard to the theoretical discussion of the photochemistry of photosynthesis, I agree with Briggs. I have myself already suggested that a number of quanta varying with the frequency of radiation may be acting in photosynthesis. On the assumption that the energy to be furnished by radiation in order to break down a molecule of carbon dioxide is equal to the heat of the reaction $CO_2 + H_2O = O_2 + \frac{1}{6}C_6H_{12}O_6$, two quanta are exactly sufficient when the wave-length is 500 $m\mu$. With shorter wave-lengths the efficiency would be smaller, because some fraction of the absorbed energy would be wasted. With larger wave-lengths the efficiency would also be diminished because the absorption of three quanta would be necessary, and some fraction of the absorbed energy would also be wasted. Direct experiments to test the theory are unfortunately not easy, since the accuracy required is very high with respect to the present state of the technique, and, above all, on account of the living nature of the material.

RENÉ WURMSER.

Laboratoire de Biophysique de
l'École des Hautes Études, Paris.

A Phenomenon of the Oscillating Arc.

SINCE the experiments of the late Mr. Duddell, at the beginning of this century, it has been well known that a carbon arc fed from a direct current circuit, and with a condenser and inductance in shunt, will oscillate at a frequency which is determined chiefly by the product of the inductance into the capacity of the condenser. Much work has been done, especially in Germany, on the conditions producing these oscillations, but it does not appear to have been noticed that such an arc will oscillate violently when the shunt circuit *contains no inductance whatever*.

Experiments which we have made recently show this phenomenon to take place whether a carbon arc is used in air or a Poulsen arc in coal gas. The frequency of the oscillation (for given capacity and supply voltage) is determined by the resistance in series on the direct current side, just as in the well-known example of a neon lamp. The following table gives particulars of a series of experiments made with an open arc between solid carbons.

OSCILLATIONS WITH CONDENSER ONLY ACROSS THE ARC.

Direct feed current in amperes (mean) .	1·6	1·9	2·15	3·0	3·1	5·6
High frequency current in amperes R.M.S. .	8·6	9·4	10·7	15·0	15	22
Arc volts R.M.S. . .	65	60	65	55	50	50
Resistance volts . .	190	192	185	175	180	180
Feed volts . . .	250	250	250	225	225	220
Capacity in μF. . .	5	5	5	20	40	40
Feed resistance in ohms	119	101	86	58	58	32
H.f./d.c. . . .	5·37	4·95	4·98	5·0	4·84	3·92
Frequency . .	1890	2280	2520	1800	940	1080

The very large ratio of the r.m.s. high frequency current to the d.c. feed is particularly interesting. Oscillograms taken of these discharges show the comparatively small current charging the condenser through a comparatively long period, the conductance of the arc gap meanwhile gradually increasing and the pressure rising, until breakdown of the arc gap occurs. The discharge which follows this is very large and very rapid; so rapid, in fact, that it is difficult to get an oscillograph the natural period and damping of which will record faithfully the occurrence.

As an instance of such observations on an arc 1 mm. long, the current charging a condenser of 216 μF. through a feed resistance of 31·6 ohms, and with a d.c. p.d. of 215 volts, averaged 1·76 amperes, lasting for 40×10^{-4} seconds. The maximum discharge current was 126 amperes, and the time of discharge about 5×10^{-4} seconds.

Besides their scientific interest, these experiments are of practical importance to engineers, inasmuch as they show how a cable on any system (which has considerable capacity and little inductance) may cause violent disruptive effects if the insulation gives way at any point.

WILLIAM CRAMP.
A. P. JARVIS.

The University, Edgbaston,
Birmingham, Nov. 18.

The Tides of the Upper Atmosphere and the Heights of Meteors.

IN NATURE of April 27, 1929 (vol. 123, p. 642), it has been mentioned that an examination of the two maxima of the frequency curve of the heights of the bases of the aurora led to the conclusion that at 70° latitude the mass of air situated above 100 km. over the ground at ebb-tide is equal to the mass of air situated above 106 km. at flood-tide.

Since then an attempt has been made to investigate the same subject by considering the heights of meteors. The material used is due to the Danish private

astronomer Torvald Køhl (*Oversigt over det Kgl. Danske Vidensk. Selsk.'s Forh.*), and it consists of 142 measurements of the lowest observed points of meteors (*limes inferior*). The material, obtained in latitude 56° N. during the years 1875–1917, is very accurate, the mean error of the heights being less than 1 km.

The mean height of the *limes inferior* depends on the mass of air above this limit. Therefore, if the tides of the upper atmosphere have no phase-difference in relation to the tidal forces (which is nearly the case at ground level), the mean height of the lower limits may be expected to vary in the following manner :

$$h = h_0 + l \cos 2t$$

where h_0 is the mean height and l the amplitude of a variation depending on the moon's hour-angle (t). The material has been divided arbitrarily into two parts, and then each of these parts is divided in accordance with the moon's hour-angle, namely :

(1) flood-tide : $-30° < t < 30°$ and $150° < t < 210°$;
(2) $+0$: $30° < t < 45°$, $135° < t < 150°$, $210° < t < 225°$ and $315° < t < 330°$;
(3) -0 : $45° < t < 60°$, $120° < t < 135°$, $225° < t < 240°$ and $300° < t < 315°$;
(4) ebb-tide : $60° < t < 120°$ and $240° < t < 300°$.

The following table gives the mean values of h in kilometres :

Years.	Flood-tide.	+0	−0	Ebb-tide.
1875–1902	87·7	90·6	81·0	79·9
1904–1917	92·7	88·6	78·8	82·8
Whole period	89·3	89·4	79·6	81·6

From these values are found : $h_0 = 85{\cdot}0 \pm 1{\cdot}2$ km. ; $l = 5{\cdot}5 \pm 1{\cdot}9$ km., thus :

$$h = 85{\cdot}0 + 5{\cdot}5 \cos 2t \text{(km.)}.$$

Assuming from theory that, on an average, the meteors will be extinguished when they have passed through the same mass of air, the expression for h shows that the mass of air situated above 90·5 km. at flood-tide should be equal to the mass of air situated above 79·5 km. at ebb-tide. The corresponding values formerly found by the investigation concerning the aurora were 106 km. and 100 km., respectively. Taking into consideration that the former phenomenon is observed in latitude 56° and refers to heights about 85 km. above the ground, while the latter phenomenon is observed in latitude 70° and refers to heights about 103 km., a fair agreement between the two results will be found.

A further examination of other and if possible more numerous observations of lower limits of the meteors would be of importance for the investigation of the tides of the upper atmosphere. J. EGEDAL.

Geofysisk Afdeling,
Meteorologisk Institut,
Köbenhavn, Nov. 2.

The Oxidation of Acetaldehyde by Oxygen.

IN the course of experiments which have been carried out during the last two years on the photochemical oxidation of acetaldehyde, an observation has been made which does not seem to be recorded in the literature. It has been found that when pure liquid acetaldehyde is shaken at ordinary temperature with oxygen in daylight or in the dark, a rapid absorption of gas occurs and a peroxide is formed. 2 c.c. of liquid aldehyde, shaken for one minute with oxygen, absorb more than 1 c.c. of gas, and on adding the liquid to a solution of potassium iodide, iodine is liberated equivalent to about 8 c.c. of n/100 thiosulphate solution.

The formation of peroxides under these conditions from other aldehydes has long been known, and Bäckström (*Medd. K. Ventenskapsakad.* Nobel-Inst. 6, No. 16) has recently investigated the chain mechanism of peroxide (benzoperacid) formation in the case of benzaldehyde. Bäckström assumed that the photochemical rate of peroxide formation is proportional to the light intensity. Mr. Chatwin, working in this laboratory, has shown that the rate of benzoperacid formation is more nearly proportional to the square root of the light intensity.

We have obtained similar results for acetperacid formation when gaseous acetaldehyde and oxygen are exposed to ultra-violet light. The reaction rate is high, indicating a long chain mechanism, and is approximately proportional to the square root of the light intensity, proportional to the aldehyde concentration, and independent of the oxygen concentration. These facts can only be explained by a mechanism of the following type :

1. $A + h\nu \longrightarrow A^+$
2. $A^+ + O_2 \longrightarrow AO_2^+$
3. $AO_2^+ + A \longrightarrow A^+ + AO_2$
4. $2AO_2^+ \longrightarrow ?$

That is to say, the chain mechanism given by reactions 2 and 3 must be assumed to be terminated by the reaction 4 to explain the observed kinetics. This otherwise improbable mechanism is rendered possible by the great length of the reaction chains.

We are now carrying out experiments on the oxidation of acetaldehyde in solutions, and full details of all the measurements will be published when further results are obtained. E. J. BOWEN.
E. L. TIETZ.

Physical Chemistry Laboratory,
Balliol and Trinity Colleges,
Oxford.

New Phenomena in a Sounding Dust Tube.

I HAVE found the clear photographs of the antinodal ring of dust in a Kundt's tube which were published in NATURE on Nov. 9, p. 724, by Prof. Andrade and Mr. Lewer of special interest inasmuch as, while using a rod excited tube and *Kieselsäure* powder, I observed (*Phil. Mag.*, vol. 7, p. 523, March 1929) an antinodal cloud and stated that "the antinodes are marked almost as definitely as the nodes". As the dust was photographed when the note had ceased, a photograph as detailed as that of Prof. Andrade and Mr. Lewer was not obtained, although a ring-like grouping at the antinode is clearly suggested in Fig. 7 (*c'*) (l.c.).

I have observed that the striæ tend to lean over towards the nearest antinode and, in the photograph published in NATURE, it may be seen that this tendency is marked to a minor degree. Also in my paper I pointed out that the figures depend largely on the powder used, and it would be of interest if, in their fuller account, Prof. Andrade and Mr. Lewer state the material they employed and the diameter of their tube.

Like Crofutt (*J.O.S.A. and R.S.I.*, **14**, p. 431, May 1927) I have used a valve oscillator to obtain striæ, and I was—before my experiments had to be temporarily suspended some months ago—photographing the figures kinematographically. The results of this investigation I hope to publish in due course. and, in the meantime, I look forward with interest to the contribution Prof. Andrade and Mr. Lewer have promised to make to this fascinating subject.

ERIC J. IRONS.

Department of Physics,
East London College, London, E.1,
Nov. 19.

'R 101.'

By Prof. R. V. SOUTHWELL, F.R.S.

AT dawn on Saturday, Oct. 12, 'R 101' was taken from her shed at Cardington and brought, without difficulty or delay, to her anchorage at the mooring mast. The week-end was devoted to tests of her engines and ballasting equipment; but on Monday, Oct. 14, with fifty-two people on board, she left the mast and cruised for about 5½ hours over the home counties and London. Such tests and measurements as could be made during the flight indicated that the airship fulfils in every way her designers' expectations; with three engines running at cruising power, an average air speed of about 58 miles an hour was maintained.

On Friday, Oct. 18, a second flight was made. Air speeds well in excess of 60 m.p.h. were attained, and again the manœuvre of 'coming to the mast' presented no difficulty, although it took longer on this occasion, because the airship was found, on nearing ground level, to have an unexpectedly high 'lift' (or buoyancy). Between her first and second flights 'R 101' had been subjected at the mast to winds of considerable strength and variability, accompanied by sudden changes of temperature: her behaviour gave no grounds for anxiety, and seems to justify (so far as it goes) the preference which the Aeronautical Research Committee has expressed for this scheme of mooring in comparison with others that have been proposed. As I write, 'R 101' lies again in her shed, having left the mast to make room for the Burney airship 'R 100', due to arrive from Howden.

So for the first time since 1921, when failure of a girder resulted in the total loss of 'R 38', an airship designed and constructed in Great Britain has been seen in flight. Naturally 'R 101' has aroused great interest, and the merit of her initial achievements has been admitted even by journals which, a month ago, were fulminating at once against the mistakes of her design and the impenetrable secrecy by which those designs had been surrounded. Optimism is once more in the ascendant, and sanguine predictions are being made regarding 'R 101', 'R 100', and their successors.

The danger of such optimism is that, being a plant of very rapid growth, it is liable to wilt in the chill of even a temporary set-back; therefore I cannot feel that true service is rendered to the cause of airships by suggestions that all their difficulties have been overcome. The *Times* (which almost alone among our daily papers has maintained a rational and consistent attitude towards 'this airship business') put the matter clearly in a sentence of its leader of Oct. 15: "After all, R 101 is admittedly experimental". Four years ago I stressed the same aspect in an evening discourse to the British Association[1]: "I wish that the public could be induced to see this airship construction as a great adventure: the goal, ability to fly to India, in comfort and without change, in the space of 100 hours; the problem, to design and construct a ship of vast capacity, with little help from past experience, by sheer hard thinking and hard work." Then I was pleading for (what has not been accorded) suspense of judgment on the new designs until their problems should have been worked out. Now, when 'R 101's' designers are receiving the plaudits they so richly deserve, it is still the aspect of adventure that I should wish to stress; but now for the reason that, counting too confidently on success, we may slacken in determination to surmount the difficulties that remain.

In 1925, only main outlines had been decided in the design of 'R 101'. I shall try to state briefly, first in what respects I consider that the anticipations of those days have been realised, and afterwards, in what respects the available evidence seems to me to be either negative or incomplete. I need scarcely add that my views carry no weight of authority, and are based on no exclusive information; my contact with 'R 101' has been solely in relation to technical problems of stress calculation, except in so far as I have been permitted by the kindness of the staff at Cardington to watch the progress of their work.

In my discourse to the British Association I ventured to defend the policy of the Air Ministry which, after four years' stagnation in airship construction, was then embarking on the adventure of ships just twice as large as any that had been built previously. I had been speaking of the "dimensional handicap"—equally ruthless in its pressure on birds and aeroplanes—which "makes our problem harder when we go to greater size", and I had said: "I do not say that we have yet reached a limit in respect of size of aeroplanes: new materials, new principles of construction and, above all, new types of engine may relieve the pressure of the laws which I have been discussing. All that I am concerned to show is that this pressure will be merely 'postponed'". But, as I went on to show, the airship, which relies for its 'lift' upon its buoyancy, "experiences a relatively insignificant dimensional handicap in the stresses which it has to sustain. . . . By doubling every dimension, we obtain an airship which will carry eight times as much load, and can withstand winds of the same strength as before." Its parallel in Nature (according to my argument) is to be found, not in the bird, but in the whale.

I urged, further, that a certain advantage can in fact be expected to accrue from increased size. "Suppose that we took an existing airship (R 33, say) and decreased every dimension by two. According to dimensional theory it could still fly and it would have adequate strength, but in reality its construction would have become impossibly flimsy. . . . Conversely, by increasing the size, and employing material of stouter gauge, we lessen the importance of corrosion, . . . we render possible methods of construction which were not practicable

[1] Brit. Assoc. Reprint No. 19.

before, . . . and we lessen the chance of accidental damage." I think it may be said, speaking generally, that these contentions have been sustained. 'R 101' is robust; the scantlings of her steel girders are such that full advantage could be taken of experience gained in the construction of metal spars for aeroplanes; and simple joints could be provided by which the ship was assembled rapidly, as though from the elements of a vast 'Meccano' set. What this means in simplicity of construction can be realised from Fig. 1, in which two typical joints are compared,—one from 'R 101', the other of 'Zeppelin' construction, and both fulfilling almost exactly the same purpose. The 'Zeppelin' joint involves a large amount of hand riveting *in situ*: in 'R 101', finished members are assembled by a mere insertion of bolts and nuts.

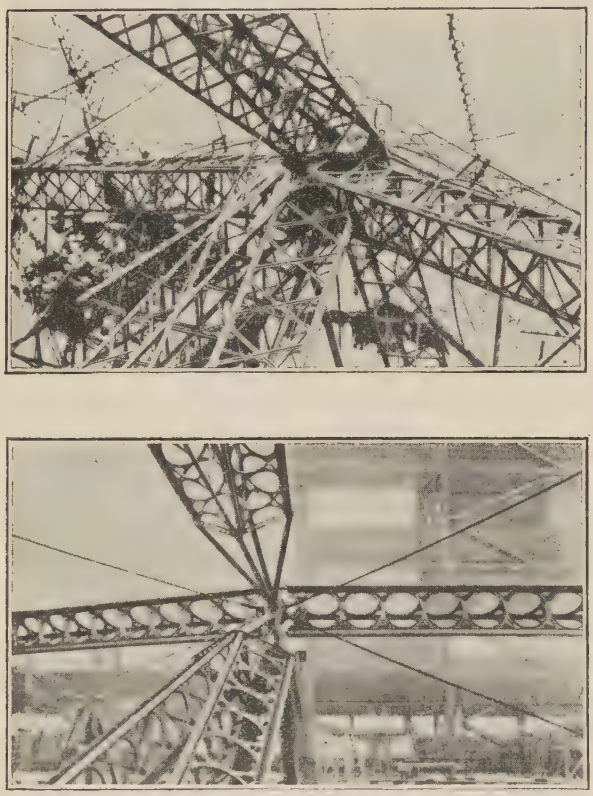

FIG. 1.—Typical joints, above, of 'Zeppelin' construction, below, from 'R 101'. Royal Air Force official: Crown copyright reserved.

In one respect, admittedly, the advance to greater size was an advance into the region of the unknown. It is a commonplace of aerodynamical theory that model tests, in the present state of knowledge, afford no certain indication of the characteristics to be expected in the full-scale. Therefore at the National Physical Laboratory, when we based on such tests our recommendations in regard to shape of hull, we were careful to make only guarded estimates of resistance (that is, of speed), and to emphasise that the amount of 'balance' suggested for the control surfaces might prove on trial to be either insufficient or excessive. We believed that our estimate of speed would prove to be conservative, and that the hull would be satisfactory in respect both of stability and control; but we hesitated to base quantitative figures on models which had perforce to be made on a scale of about 1/20 inch to 1 foot, and Cardington accordingly decided to provide 'Servo-motor' auxiliaries for working the controls, in case these should prove 'heavier' than was expected.

According to the *Times* report of Oct. 16, 1500 h.p. sufficed in the first trial to give the airship a speed of 58 m.p.h. It may be deduced with practical certainty (since the power required will vary as the cube of the speed) that with her five engines giving 700 b.h.p. each (the figure contemplated originally) 'R 101' could have developed a speed of 77 m.p.h.,—which is slightly in excess of her estimated speed. Recourse to the Servo-motor gear was not found necessary (if this holds good at full speed the gear may be removed, and then about ½ ton will be added to the useful 'lift'), and the stability of the ship was reported to be entirely satisfactory. Thus the trials, so far as they go, give no support to those critics who upbraided the temerity of our decision to recommend a shape considerably less elongated than those of past German airships. I have never been able to understand the reasoning which convinced them (quite independently of any question of 'scale-effect') that the new shapes must prove specially difficult to control; on the structural side it should be obvious that the hull (which is a girder, serving to transmit the concentrated loads of the passengers and engines) must benefit by being made relatively short and deep. Perhaps they failed to visualise the meaning of a 'fineness-ratio' of 5·5: as Fig. 2 indicates, the shape of 'R 101' is short in comparison with earlier ships, but it is not appropriately described as 'plump'.

Space does not permit a description of the many ingenious devices which Col. Richmond, the chief designer, and his small band of assistants have incorporated in their design. The interested reader may be referred to the *Journal of the Royal Aeronautical Society*, August 1929, for a full description, and I must be content here to express the unqualified admiration I have learned to feel for their work—an admiration which will persist even if (as I do not expect) 'R 101' is ultimately pronounced to be a failure. I turn now to the other side of the picture—the problems which still await solution.

The Achilles' heel of 'R 101', so far as it is possible to judge at present, is her power plant. No one is to blame for this circumstance, but it cannot be denied, and it is very serious. Designed to carry five engines of 700 b.h.p., 'R 101' can at present count only on four, and these will not develop continuously more than about 600 b.h.p. each.[2] So her designed power has been reduced by more than 30 per cent, and the 77 m.p.h. which she should attain at full power is replaced by a figure slightly under 68: against a head wind of 60 m.p.h.

[2] See letter from the Editor of *Aircraft Engineering* in the *Times* of Oct. 23, and lecture on "The Machinery Installation of 'R 101'" (T. R. Cave-Browne-Cave) in the *Journal R. Ae. Soc.*, March 1929.

he can make good only 8 ground miles per hour, instead of 17. Moreover, the engines are *heavy*. They weigh 7 lb. per h.p. 'dry'—a figure about twice as high as that which Mr. Chorlton, their designer, considers to be possible now, and was believed to be possible when the design of 'R 101' was started. Five tons will be added to the useful load if and when these hopes are realised.[3]

The 'troubles' which have led to this result were enumerated by Wing-Commander Cave-Browne-Cave in his lecture to the Royal Aeronautical Society: torsional resonance of the crankshafts (a fault which is difficult to remedy at a late stage in design) has necessitated increased weight and delayed the fitting of "variable pitch airscrews"; the aluminium crankcases gave trouble (as originally designed) and have been replaced by steel. Wing-Commander Cave remarked that "none of the major troubles has been due to the engine working with heavy oil". In a strictly technical sense this statement is true, but in the wider aspect it may be misleading; for the decision to use heavy oil meant that special engines had to be designed *ab initio*, whereas, had petrol been the intended fuel, engines of tried reliability could have been incorporated.

Let me say at once that I consider the Air Ministry's decision, based on its determination to aim at 'safety first', to have been in every way right and wise. Airships in Great Britain have still to win public confidence, and a disaster sustained by either of the new ships would probably result again (as in 1921) in a total cessation of construction. The difficulty that has arisen is solely a matter of time: *a new engine, working on a relatively novel principle, takes longer to perfect than an airship hull.*

In the original project, 'R 101' was planned to run on heavy fuel oil, using engines which were to be developed from a marine type weighing about 100 lb. per b.h.p. The high flash-point of the fuel would eliminate the danger of fire occurring in tropical temperatures; greater distances could be flown on a given weight of fuel; and the cost of fuel would be largely reduced. In 'R 100' the same objectives were to be attained by the use of engines burning a mixture of paraffin and hydrogen,—thus utilising gas which otherwise would be valved, and so wasted. The latter engines have not materialised, and 'R 100' is, for the present, to burn petrol after all: 'R 101', as we have seen, has attained her objective, but at a serious cost in loss of speed.

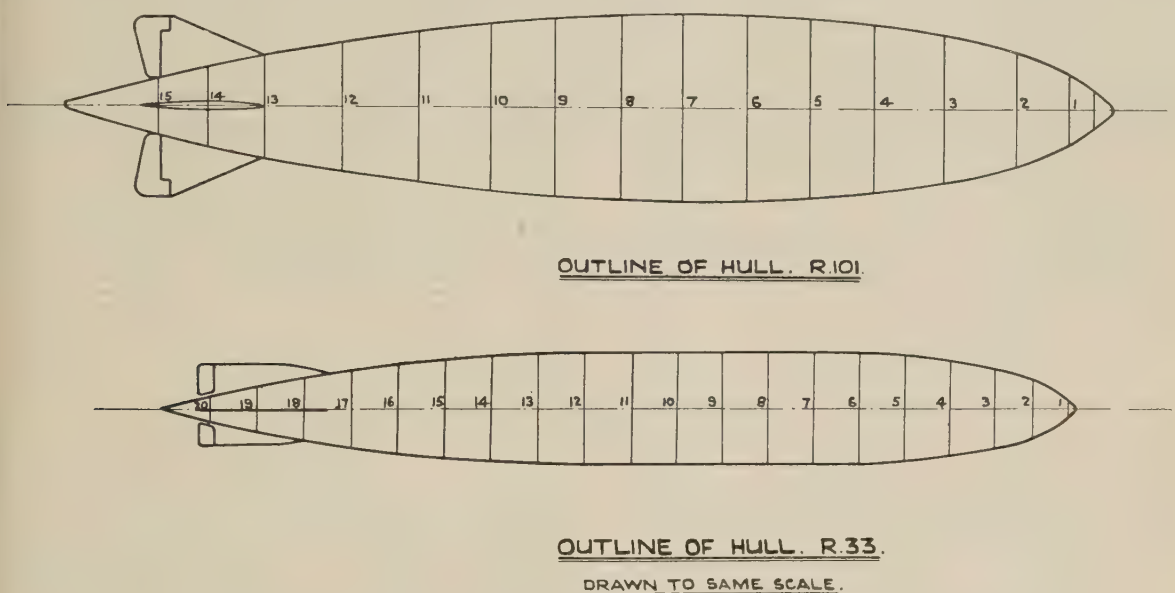

FIG. 2.—Outlines of hull of 'R 101' and 'R 33'. Royal Air Force official: Crown copyright reserved.

The consequence is that these two airships, originally intended to be exactly comparable and so to test the relative efficiency of 'official' and independent commercial design, are not directly comparable to all. 'R 100', with her six Rolls-Royce engines, can count on 4200 b.h.p.,[4] but she cannot (according to the standards originally imposed) safely be flown in the tropics. 'R 101' is safe to fly as regards fire risk, but her depleted speed introduces an element of danger of another kind, and in really strong winds her captain will have anxieties for which her designer is in no way responsible. From the scientific point of view one must regret that she, too, has not been equipped to run on petrol, as a temporary expedient, until such time as her heavy-oil engines have been brought more closely into accord with their intended performance. A year spent in temperate climates—on flights planned with a view to the accurate measurement of speed, controllability, hull stresses and the like—would yield knowledge

[3] See Mr. Chorlton's letter in the *Times* of Oct. 19.

[4] "The World, the Air and the Future" (Burney), p. 210.

of incalculable value regarding the merits of the new designs, and would enable the flights to Egypt and to India to be planned with greater confidence. Both airships are experimental, and the experiment ought not to be hurried at any cost in added risk.

As matters stand, comparison is still possible, but it must be made with care: relative figures, if given without full explanation, may be entirely misleading. Thus, in regard to speed, the measured performances of the two ships must be 'corrected' (according to the cube law which expresses the power-speed relation) in order that their hull resistances may be compared on a basis of equal power; the fact that they carry widely different power plants is (speaking scientifically) an irrelevant circumstance which this procedure will serve to eliminate. Similar remarks apply to the question of useful lift, or 'pay load'; the heavier engines carried by 'R 101' must not be allowed to detract from our estimate of her structural design, nor from this point of view is she entitled to credit for the fact that 1 ton of heavy oil represents a wider radius of action than 1 ton of petrol. *Either ship might have been fitted with either power plant*; therefore the hulls must be compared for efficiency, as engineering structures, on a basis of the total weight which they can carry, for the same quantity of hydrogen, in passengers, crew, furniture, engines, and fuel combined.

Finally, the comparison must be made on a basis of figures ascertained in actual flight, not on estimates. How easily the latter may be in error is indicated by the remark that at least a ton of dust had settled on 'R 101' during her time of waiting in the shed.[5] Useful lift can be *estimated* only as a (relatively) small difference between two large quantities: when the hull is air-borne it can be *measured* with certainty. Estimates, it is safe to say, have been the curse of airships: so hard to check, when airship flights are as infrequent as solar eclipses; so easily modified to suit the thesis of the moment, whether sanguine or condemnatory.

The enthusiast, whose millenium is always five years ahead, can seldom resist the temptation to detract from actual achievement, in order that the advantages of his new project may be displayed in stronger light; he forgets that it is only on achievement that the outside world, with sound instinct, will base its expectations and its support of airships. To those who have the progress of airships most at heart, it is a relief to pass from a period of words and 'estimates' to a period in which the new ships must stand their trial. Very soon now we shall know with certainty the relative merits of 'R 100' and 'R 101', and how they compare with the airships of other countries; then, but not until then, can future projects be based on sure foundations.

[5] *Times* of Oct. 14.

The British Association in South and East Africa.[1]

By Sir RICHARD GREGORY.

WHEN the Prince of Wales was president of the British Association at the Oxford meeting in 1926, he made particular reference in his address to the value of meetings of the Association overseas in creating interest in science and co-ordinating the work and results of scientific investigators throughout the Empire. "Nothing but good", he remarked, "can follow from personal contact between scientific workers in different parts of the Empire. Nothing but good can follow from their researches if they add, as gradually they must add, to the wider knowledge of the Empire not only among the workers themselves, but ultimately among the whole body of informed Imperial citizenship; not only in the overseas territories, but also at home."

As one of the main functions of the British Association is to bring home to the public the significance and value of science to human life, nothing now would seem more natural than to extend these activities occasionally to fields of the Empire overseas and not to confine meetings to the British Isles. More than half a century elapsed, however, from the foundation of the Association before the first overseas meeting was held at Montreal in 1884. Since then meetings have been held twice in South Africa, once in Australia, and in Canada again in 1897 and 1909, and every meeting has had very decided influence in stimulating scientific work in the country visited as well as engaging the interest of the visitors in the solution of new problems. There is no longer any doubt as to the importance of acquiring first-hand knowledge of our overseas territories, or need to emphasise the good that results from personal contact between workers in various parts of the Empire. Co-operation and co-ordination are essential to avoid waste of effort and secure rationalisation in science, and the British Association is greatly assisting progress towards this end by its overseas meetings.

The world has to look to tropical agriculture for a large part of its food supply and raw materials in the future, and to ensure that this will be forthcoming it is essential that the fullest scientific knowledge should be available and used to protect crops from the pests which continually assail them in tropical countries. In Africa in particular, the facts to be faced and the problems to be solved are set forth most convincingly in the Report of the Parliamentary Commission of Inquiry to East Africa in 1924 and in Mr. Ormsby-Gore's report on the four British West African territories in 1926. One of the most gratifying features of the former report was the recognition of the economic value of scientific guidance to such countries. Mr. Ormsby-Gore was chairman of the East African Commission, and he had the advantage of co-

[1] From an address on "Science and the Empire" given on Dec. 3 at a meeting of the Royal Empire Society in co-operation with the British Association, following upon the recent meeting of the Association in South Africa.

operation with a scientific colleague, Major A. G. Church, secretary of the Association of Scientific Workers. The two reports emphasise the urgent necessity for applying the methods and results of science to the problems of tropical development, both in administration and production.

The meetings at Cape Town and Johannesburg afforded an opportunity for comparative study of man in Africa and Europe, and resulted in valuable discussions on material archæology and physical anthropology of Africa. The resemblance of the Stellenbosch type of stone implement to the Acheulean type in south-west Europe, of the majority of the rock paintings in South Africa to those of eastern Spain, and of skulls like those recently obtained by Mr. Leakey in Kenya, approaching the European in type, suggest that early man reached Europe from Africa. Though the peoples represented by these cultures and characteristics may have had some part of Asia as their primeval home, there is evidence that north Africa or south-west Asia was at any rate a secondary centre from which they diverged to south-west Europe, to south India, and to equatorial and south Africa. The continuation of Mr. Leakey's work promises to lead to new interpretations of movements of early culture in Africa, and may throw light on the evolution of modern African types of man. There is urgent need for support on a large scale for research of this kind, and investigations into related ethnographical problems in Kenya and the rest of East Africa. If a generous benefactor could be found to endow an anthropological research institute in East Africa, a very valuable service would be rendered to mankind as well as to the British Empire.

Of the value, and indeed the necessity, of a practical application of the science of anthropology in native administration there can be no question. Without anthropological knowledge it is impossible to predict what will be the effect of interference with any native custom, even though on one hand it may seem repugnant to European ideas, or on the other of so trivial a character that its repression may seem a matter of no importance. Anthropology, studying each custom and each belief as it functions in a given social environment, traces it through its various ramifications in the whole cultural complex, and is thus able to show the consequences throughout the whole social fabric when any attempt is made to modify or suppress that particular custom. The attempt to advance the status of native women in South Africa by abolishing the 'bride price' failed through misunderstanding and imperfect knowledge of the facts. Until the custom was reinstated there was no stability in family or tribal life. Another example of a measure introduced with the best of intentions and having only the well-being of the native in view, but which failed through lack of knowledge, is afforded by the order issued in one of our dependencies to destroy all rats with the object of stamping out plague. To carry out this order effectively the roofs of native huts had to be taken off. To the surprise of the officials of the health service, this was the cause of great resentment among the natives. On inquiry, however, it was found that as a matter of religious custom the unroofing and re-roofing of each hut made the sacrifice of a goat incumbent upon the owner. A knowledge of anthropology would have averted the creation of what might have been a serious situation. It must indeed be understood that the development of a backward people along natural lines demands from an administrator an intensive study of their customs, their religions and modes of thought, guided by a training in the methods of anthropological science.

Another aspect of the 'native problem' is that of agricultural development. South African agriculture is essentially based upon unlimited supplies of cheap native labour, and the implements and methods, for example, bullock waggons for transport, reflect this condition. In a sense, the period of development corresponds to British agriculture in the middle of the eighteenth century, but superimposed on this are the resources of modern agricultural science through the introduction of new varieties, animal breeding, marketing, and cold storage facilities, and these have enabled it to carry on and even to develop an export trade. If the native problem becomes more acute, and a higher standard of living leads to demands for higher wages, it will necessitate a complete reorganisation of South African farming. The great difficulty of running a farm successfully at present, except in a few favoured spots, is due almost entirely to climatic conditions, or in other words, the supply of water. This involves the problem of irrigation; and here it may be said incidentally that the excellent soil survey work that is being carried on has provided the irrigation department with most valuable information upon which to base irrigation projects. As irrigation is costly, only luxury crops can be grown in such districts with hope of financial success; hence the concentration on citrus fruits. It is improbable, however, that South Africa can ever export enough to control our markets, and attention should therefore be devoted to high-grade supplies, which means drastic grading of fruit prior to export. The wine industry is most promising, and the Empire Marketing Board should do more to make its products better known in Great Britain.

The afforestation schemes in different parts of South Africa, and the rapid development of sugar-cane and wattle growing in Natal, are particularly noteworthy. As the recent debate in the House of Commons showed, one of the subjects with which almost every country is at present preoccupied is the question of the future supplies of softwood timber, and foresters are in consequence interested in all efforts to increase softwood production. In South Africa the percentage of land under forest is very low, and the indigenous softwoods, although they produce good timber, are slow growing, and difficult to establish on the veld, hence of little value in the extension of forest area. South African foresters, however, have shown enterprise in seeking for tree species which will grow well

under the various conditions in their country, and from the large number which they have tried, they are now carrying out extensive afforestation with pines from the Monterey Peninsula in California, the Mediterranean Basin, the slopes of the Himalaya Mountains, the Canary Islands, Mexico, and Central America. For hardwood production Australian species, particularly *Eucalyptus*, are being used. The results of this work will be of assistance to foresters who have to deal with similar conditions in different parts of the Empire, and the publication of the papers prepared by the South African foresters for the British Association meeting will disseminate the knowledge so far obtained. This experiment on the creation of an entirely new forest complex raises forest problems of great diversity and interest in soil biology, pathology, and methods of tending the plantations, and the discussions between the European and South African foresters resulted in the pooling of the knowledge at present available, and suggested lines for future investigation.

Farther north, for example in Northern Rhodesia, forestry is only beginning to be developed. The first step is the survey and stock-taking of the indigenous forest resources, and this necessitates the identification of the many different tree species. Even in a country such as Nyasaland, where a forestry service has been developed for some time, owing to pressure of administrative duties, work of this kind remains to be done. Assistance in both colonies was given by a systematic botanist, Dr. J. Burtt Davy, during his visit to Africa.

In both South and East Africa the crying need of the moment is for workers to name the plants. The visitors were told in South Africa, and the same thing is true of East Africa, that if a botanist set to work on any square mile of the country, probably he would find at least one new flowering plant that had no name, and probably more than one. Certainly it is true that whatever interests the botanist may start with when he leaves the mother country for Africa, he is soon driven by circumstances to turn aside from a primarily physiological or other inquiry in order to ascertain what is the correct name of the plant with which he is working. This is the first need on the scientific side, but it is also true on the practical side. It is of prime importance in relation to problems in regard to poisoning of stock. Veterinary officers in Northern Rhodesia took visitors to districts and pointed out probably the plant itself, certainly the group of plants, which are responsible for producing certain symptoms in the stock grazing in that area. This they have been able to do for several years past, but they were still unable to give a name to the plant that is the cause of their trouble, and as a consequence they are no nearer an understanding of the means of eradicating the trouble, and they have no idea of the extent of the plant's distribution, its season, etc. One of the crying needs of the botanical side is more help on the systematic side.

One thing that the home botanists ought to do, therefore, is to supply the workers in this systematic field in the new country. Africa with its own active university departments, all of which have heads alive to the botanic needs of the country, will soon supply its own workers in this field. At present it needs the resources, however, of the old country. As a matter of fact, one of the ironies of the situation is that as nearly all the original work upon the Cape flora has been done by European botanists, the only places where the African plants can be named with certainty at present is in the home country in touch with the big British and European herbaria. There is, quite possibly, room for a greater development of systematic work on this type of plant material in connexion with Kew or with the Natural History Museum at South Kensington.

There are thirteen separate sections of the British Association concerned with different departments of science, and each of these held meetings at Cape Town and Johannesburg. Mr. O. J. R. Howarth, secretary of the Association, has been good enough to furnish me with the following summary of the scientific programme of the meetings:

"In Cape Town and Johannesburg there were some 350 addresses, lectures, papers, and discussions in all. Of these, fully one-third were on specifically South African topics, and many of them were contributed by South African scientific workers. To mention only a few as examples—the chemists dealt with essential oils from South African plants, with recently discovered nitrate deposits in South-West Africa, and with the chemistry of gold extraction. The geologists were concerned in very large measure with the geology of the sub-continent: they not only heard papers on it, but studied it widely in the field, co-operating with the International Geological Congress (which coincided with our own meeting) in order to do so. Geologists, zoologists, and botanists combined to discuss the debatable subject of the lost continent of Gondwanaland.

"A large part of the zoological and botanical programmes had a definitely South African bias, and both sections benefited by exhibits and demonstrations arranged for the instruction of the visitors. The discussion organised by the Sections of Zoology, Botany, and Physiology on 'The Nature of Life' was opened by our most distinguished South African member, General Smuts. The Section of Geography, under the presidency of the Director-General of the Ordnance Survey, Brigadier Jack, devoted an important part of its programme to the progress of surveying and cartography in South Africa; and it studied a whole series of aspects of human environment, such as the effects of relief of the land upon settlement, economic development under desert conditions, water-supply, soils, and so forth. It also joined the Section of Education in discussing the teaching of geography, with special reference to South African schools and universities.

"The Economics and Anthropological Sections united to consider economic competition between advanced and backward peoples, and covered a wide field of South African economic problems. The Engineering Section dealt appropriately with

refrigeration, road and rail transport, town planning, irrigation, and mining machinery. The Anthropological Section, it need scarcely be said, was in its element: chief among many features of topical interest it received Miss Caton-Thompson's report upon her excavations at Zimbabwe and other sites in Southern Rhodesia, carried out at the instance of the Association, and confirming the medieval origin of the buildings in the face of romantic ideas as to their much greater age. The physiologists and engineers jointly considered problems connected with the ventilation of deep mines on the Rand and elsewhere. The psychologists contributed their results associated with some of the population problems of South Africa. The Educational Section devoted itself almost wholly to South African topics: and lastly, the Agricultural Section had the unique opportunity of meeting jointly, in Pretoria, with the Pan-African Agricultural and Veterinary Congress."

There can be no question as to the stimulus which consideration of these and other subjects has given to science in South Africa, or in the interest which has been created among the visitors in the scientific and economic problems of the country. Everywhere the scientific staffs, research workers, and planters were eager to get into touch with visitors possessing intimate knowledge of their subjects, and to seek advice as to deductions to be drawn from work in South Africa or suggestions for further activities. The foregoing general survey represents not only personal conclusions as to the place of science in the development of the Empire, but also the views of competent authorities upon specific problems in South and East Africa. Among those with whom I have had conversations or correspondence, and to whom I am indebted for information, are Prof. H. J. Fleure, Mr. E. N. Fallaize, Dr. B. A. Keen, Dr. H. M. Steven, and Prof. J. H. Priestley. We all aim to advance progress and promote human welfare, and many of us are convinced that this can be attained only by scientific guidance. Upon statesmen and administrators is the responsibility of seeing that this guidance is rightly regarded and effectively used.

Obituary.

DR. J. C. MELVILL.

DR. JAMES COSMO MELVILL, of Meole Brace Hall, Shrewsbury, well known as a conchologist and botanist, who died on Nov. 4, was born in London on July 1, 1845, and was the son of James Cosmo Melvill, Under-Secretary of State for India, and the grandson of Sir James Cosmo Melvill, F.R.S., chief secretary of the East India Company. He was educated at Harrow and Trinity College, Cambridge, and entered the business of his uncle, Edward Hardcastle, travelling in North America, where he had opportunities for studying natural history and making collections. He later joined the firm of Messrs. G. and R. Dewhurst, of Manchester and Preston, serving as a director for many years.

While at Harrow Dr. Melvill published, in conjunction with the Hon. F. Bridgeman, "The Flora of Harrow". In later years he accumulated and arranged three-quarters of the known plants of the world. The greater part of this fine herbarium, containing many valuable plants and including some obtained by Charles Darwin during the voyage of the *Beagle*, was presented to the Manchester Museum in 1904. The remainder, which consist of the grasses and ferns of the world, together with about a third of the known seaweeds, will shortly be added to the others at Manchester.

Dr. Melvill began to collect shells at the early age of eight, and during his lifetime this collection grew to be the largest known in private hands, comprising 22,500 species. He described more than 1000 new species of mollusca, by himself or in collaboration with others, including the late Robert Standen. His conchological contributions are very numerous, and comprise descriptions of species from South Africa, the Persian Gulf, the Arctic and Antarctic regions. He joined the Conchological Society in 1880, and was president in 1889 and again in 1895–96, on each occasion delivering an excellent address. He was an original member of the Malacological Society (founded in 1893) and was its president at the time of his death.

In addition to botany and conchology, Dr. Melvill took a keen interest in British insects and made quite a large collection. He was a member of the Linnean, the Zoological, the Entomological, and the Manchester Literary and Philosophical Societies, being president of the last in 1897–99. For many years he was on the Court of Governors and the Council of the University of Manchester. He was a member of the Manchester Museum Committee, being chairman for several years. During his residence at Meole Brace Hall, he was honorary curator of the Shrewsbury Museum and served as president of the Caradoc Field Club.

An all-round naturalist, Dr. Melvill's knowledge of the mollusca was masterly, and on the occasion of the Victoria University conferring upon him the D.Sc., Prof. Lamb remarked: "It is chronicled of Solomon that he spake of trees, from the cedar that is of Lebanon, unto the hyssop that springeth out of the wall, but it is not recorded that he also knew by heart all the shells from the Arctic Circle to the Persian Gulf. That double weight of learning was reserved for the accomplished systematist, Mr. Cosmo Melvill, and those who know him will testify with what gracious modesty he sustains it."

J. WILFRID JACKSON.

WE regret to announce the following deaths:

The Hon. Sir John Cockburn, K.C.M.G., president of the Child Study Society, who was premier chief secretary in 1889–90 of South Australia, on Nov. 26, aged seventy-nine years.

Mr. Francis A. J. Fitzgerald, head of the Fitzgerald Laboratories, Niagara Falls, and president in 1916 of the American Electro-Chemical Society, on Oct. 26, aged fifty-nine years.

News and Views.

JEAN BAPTISTE PIERRE LAMARCK died one hundred years ago, on Dec. 18, in his eighty-sixth year—a master of zoology whose work and thoughts gave fresh impetus to the progress of biology in his day, and in ours still enliven the unsettled controversy concerning the heritability of 'acquired' characters. Lamarck was a systematist, and in these days when systematics is apt to be despised among the multiplying branches of zoology, it is well to be reminded that it was on his experience in the discrimination of species that his great achievements were based. The earliest of these bore upon the classification of animals. He investigated the rich fauna of fossil mollusca in the Tertiary beds of the Paris basin, discovered that different species were distinctive of different beds, and gave at once an auspicious start to the palæontology of invertebrates and a lusty push to the stratigraphical conception of geological formations which his contemporary Werner had inaugurated. For the first time, he proposed a reasonable division and grouping of the invertebrate animals, which, apart from the insects, Linnæus had bundled into a hotchpotch of 'Vermes'. It was characteristic of Lamarck that his mind kept revolving the greater problems raised by his detailed work. Thus the satisfaction with which he at first regarded the linear arrangement of his classification of the animal world gave way to doubt, and ultimately was replaced by the modern conception of a branching genealogical tree—a change of view which says much for the openness of the naturalist's mind at an age at which professors are nowadays compelled to retire.

EVOLUTION was in the air during the latter half of Lamarck's life, and close reasoning, founded upon a grasp of systematic detail and sequence, enabled him to make a notable advance. He thought that changing environment influenced the habits of animals as changing wants might influence habits, and new habits meant the adaptation of old structures. The crux of his position lay in his assumption that adaptations thus acquired by an individual became, without more ado, part of the stock-in-trade of its progeny. No theory has swung more completely between the poles of belief and unbelief than Lamarck's assumption of the heritability of 'acquired' characters. At the first it was assumed without proof, and was held for years as being self-evident. Weissmann gave it a blow from which it has not yet recovered, and, for years after Weissmann's analysis of the 'eighties, few zoologists of standing but regarded the transmission of acquired characters as being not only unproved but also theoretically impossible. Fortunately, modern views are more elastic, and Lamarckism in a modified form has again its supporters amongst zoologists as well as botanists.

THE gale that set in over the south-west of England on the night of Dec. 6 last rose to hurricane strength in the early hours of Dec. 7, and a gust of 108 miles an hour was recorded. Much damage is reported both to shipping and also inland. It bore a striking resemblance to the storm of Mar. 8, 1922, which also gave a gust of 108 miles an hour and reached its climax at about the same hour of the morning. Slightly higher speeds have been recorded in other parts of the British Isles: 109 miles an hour at Dunfanaghy (Donegal) on Jan. 28, 1927, and 110 miles an hour at Quilty (Co. Clare) on Jan. 27, 1920. The gale of Jan. 28, 1927, was in many respects the most remarkable of the four, in that it yielded gusts of more than 100 miles an hour, not only in Ireland but also in Scotland, and the average speed actually exceeded 80 miles an hour for a time at Dunfanaghy. Winds of this strength are very rare outside tropical hurricanes and tornadoes. One might be tempted to regard them as very nearly the extreme limit of what can be achieved by a fast-moving secondary depression, in which the air motion can often be resolved into a more or less complete circular whirl and a motion of translation, generally from west or south-west, the resultant wind being very strong where the two components are in the same direction, that is to the south or south-west of the centre. But it is doubtful whether this is the case. Sir Napier Shaw, in his well-known work on weather forecasting, mentions a gale associated with just such a fast-moving secondary that blew down hundreds of trees in Cambridge between 2 P.M. and 4 P.M. on Mar. 24, 1895. This gale may be within the recollection of some of our readers. It was doubtless considerably more severe than the recent gale, and equally destructive storms have been recorded.

THE Barton power station of the Manchester Corporation and the proposed Battersea power station of the London Power Company are good illustrations of the difficulties inherent in working large steam stations, some of which electrical engineers and chemists are now successfully overcoming. The Manchester station is attacked because it is located in open country and the fumes emitted were deleterious to vegetation. The Battersea power station is to be built in urban surroundings and near important public buildings. By appealing against the injunction made against it by the Court of Appeal, the Manchester Corporation has gained a year during which it must abate the nuisance. The successful experiments carried out at the Grove Road Station showing how sulphur fumes can be eliminated from flue gases are very promising. According to a White Paper issued by the Ministry of Transport (Cmd. 3442, London: H.M. Stationery Office, 6*d*.), the Government Committee states that the possibility of eliminating nearly the whole of the sulphur gas present in the fumes has been proved. It desires, however, that a more definite explanation of the mechanism of the oxidation of sulphurous to sulphuric acid should be forthcoming before it can report on the practicability of the process. We are surprised that the opponents of the Battersea power station do not suggest some other site and give figures to prove that it is practicable. The problem of supplying London with electricity is not an easy one. The demand now exceeds 400,000 kilowatts, the capital involved is very large,

the prosperity of many industries depends on cheap electric power, and the comfort of hundreds of thousands of citizens is involved. Purely destructive criticism is not helpful. It is easy to put spokes in the wheel of progress. Our sympathies are entirely with those chemists and engineers who are doing their best to mitigate the objectionable components present in the fumes arising from the combustion of fuel.

AT a meeting of the Royal Anthropological Institute on Dec. 3, Mr. A. Leslie Armstrong described an archæological expedition undertaken this year with the object of exploring caves in Rhodesia, and in view of the meeting of the British Association in South Africa. The cave of Bambata is situated near the summit of the mountain of that name, the highest in a group of typical granite hills lying on the south-east verge of the Motopo Hills. Through the work of the Rev. Neville Jones of Hope Fountain, and Dr. Arnold of Bulawayo, in 1918, the cave was known to contain important deposits and a frieze of wall paintings. Work was commenced here by the expedition early in June. The relic bed proved to be nearly 20 feet in thickness, and provided for the first time in South Africa a definitely stratified sequence of cultures. At the base was a Lower Palæolithic stratum, more than three feet in thickness, containing *coup de poing* of South African Acheulean (Stellenbosch) facies. This was succeeded by a deep deposit of typical Mousterian character, above which, through a thickness of more than twelve feet, was a distinctive culture exhibiting Capsian affinities, but with Mousterian tendencies or survivals. Burins were abundant in this culture, also a distinctive point, the gradual development of which was traced from a pure Mousterian point, by well-defined stages, into a slender point of almost Solutrean technique. The upper layer of the deposit contained implements of microlithic form which are apparently ancestral to the Wilton culture of the Cape. The Mousterian zone was found to include definite intercalations of Capsian layers, separated and covered by layers of normal Mousterian character. This suggests the contemporary presence in this area of the two races before the Neoanthropic influence became dominant. At the Victoria Falls it was possible to correlate the Lower Palæolithic cultures contained in the residual gravels of the Zambezi River, with definite stages in the cutting back of the river gorge. The results demonstrate the great antiquity of Palæolithic man in South Africa.

STUDENTS of psychic phenomena will find much to interest them in an article entitled "Spirit Hunting in the South Seas", which is contributed by Prof. B. Malinowski to the *Realist* for December. In it he describes a manifestation by Tomwaya Lakwabula, a famous spirit-seer of the village of Oburaku in the Trobriand Islands of Melanesia, which came under his personal observation. It has always been a question how far the medicine man or shaman has availed himself of imposture in the manifestation of his powers or how far they were due to the effects of hysteria, auto-hypnosis, or some similar abnormal psychic state. It is evident that Prof. Malinowski is something of a sceptic, at least in regard to certain points in the medium's operations. It would appear that there are two classes of seers. A minor class, and even this is not indeed numerous, visits the spirit world for short periods and receives visits from the spirits, who bring messages and foretell the future. The second class consists of the great seers who occur but rarely in the history of the people. This latter class falls into prolonged trances, not in secret as among the first class, but in the eyes of the multitude. It was one of these prolonged trances which came under Prof. Malinowski's observation, lasting for more than a week. The call to this trance comes, the natives believe, from the spirits themselves.

THE first manifestation of the spirit-seer's powers which Prof. Malinowski saw was at the mortuary wake of the chief, when after the nervous twitchings usual in such cases, the seer broke into song in a voice which was not his own but was recognised by the natives as that of the chief, and in a language which was not that of the natives, but was said to be of the spirit world. Immediately afterwards the poles and platform at the grave were violently disturbed. This, it was said, was caused by the spirit of the chief trying to return to the body. During the prolonged trance, seances were held nightly, when the villagers gathered round the hut in which the medium's body lay extended on a couch visible from the door, and attended by his daughter. Although the seer at these seances sang both in his own and in an altered voice—on one occasion there were at least two changes, and once there took place the materialisation of a small bunch of betel nuts—no messages were delivered until the sixth or seventh night. These messages dealt with practical affairs—the disposal of a canoe, the arrangements for the periodical ceremonial feast to be celebrated in memory of the deceased chief, and so forth. The voice in which these messages were delivered was not that of the chief, but of a man who was said to have been dead for some time. When the trance was over the seer appeared to be much emaciated, perhaps only natural as his food had been supplied by the spirit world, though Prof. Malinowski has his doubts on this point. He looked tired, and his mind at first seemed quite vacant; only slowly did his mental faculties return to normal. The whole account is extremely interesting, and although the very practical and apposite character of the messages from the spirit world arouses some suspicion, it seems a genuine case of an abnormal personality, possibly exploited with some skill.

THE undoubted power of the cinema as an influence in education has not, as yet, been harnessed in Great Britain. Other countries, notably Russia, Germany, France, and the United States, have elaborated formulæ for the employment of the motion picture; but we have lagged behind. Considerable expectations are, therefore, to be attached to the work of a commission of inquiry appointed by a conference of scientific and educational societies and institutions which was held on Nov. 27. In April of this year the Association of Scientific Workers took the lead by calling a preliminary conference, which appointed an organising committee. This committee acted in conjunction with the British Institute for Adult Education in drafting the report to

be presented and in calling the second conference. The report proposed the formation of a representative commission and defined its terms of reference with such breadth as to include an inquiry into the various aspects of mechanical visual and aural aids in education, films in relation to the general education and culture of the public, and the establishment of a central organisation to co-ordinate work, both research and informatory, on the motion picture in relation to general and specialist education. The constitution of the commission insures that its findings will be received with respect. The members include Prof. W. A. R. Ainsworth, who represents the Board of Education; Mr. J. W. Brown; Mr. A. C. Cameron; Major A. G. Church; Mr. E. Salter Davis; Mr. J. Fairgrieve; Sir Richard Gregory; Sir Benjamin Gott; Mr. G. T. Hankin; Mr. F. A. Hoare; Sir Percy Jackson; Dr. C. W. Kimmins; Colonel J. M. Mitchell; Prof. J. L. Myers; and it has power to co-opt additional members.

MR. ALAN E. MUNBY read a paper to the Royal Institute of British Architects on Nov. 18, on the design of science buildings. He made a strong plea for greater efficiency in building, and pointed out that a little extra expenditure often meant a disproportionately great increase in technical completeness. One of the great difficulties of the architect lies in the absence of any consensus of opinion on the part of educationists and men of science as to the appropriate equipment for specific subjects, and Mr. Munby suggested that some generally agreed outline of requirements might be formulated without undue difficulty As to the buildings themselves, the adoption of a unit will often simplify construction and assist in the allocation of space, but the architect must constantly bear in mind that the whole design must grow up together, and that the fixed fittings must be laid out on the plans, suitably spaced, at a stage to prevent the embarrassment of the general contractor by subsequent changes. After a consideration of the chief technical details, Mr. Munby stressed the importance an architect should attach to acquiring a thorough understanding of the highly specialised objects aimed at; only so can he be in a position to deal intelligently with the various schedules of requirements that may be placed before him and to give them proper amplification in detail. Otherwise, we feel that sympathy would certainly be due to the professor who told Mr. Munby that he would much rather have an architect who knew nothing about science buildings than one who thought he knew something.

THE Annual Forest Report for Finland, 1927, recently published, depicts the wonderful progress which has been achieved in the introduction of a scientific management into the forests in the ten years since she established her independence during the period of the Kerensky Government in Russia in 1917. Apart from the notable position Finnish timbers have obtained in the European soft wood export trade (she exported 1,283,000 standards of sawn material during the year), there are other important directions in which Finland has been dealing with the forestry question from the point of view of the economic necessities of the country as a whole. Finland is mainly a forest country; out of a total superficial area of 14,151,052 hectares, the forest and waste lands cover 13,449,387 hectares. Any effective administration of the country must therefore inevitably be intimately bound up with a proper management of the forests. That this fact has been thoroughly appreciated the Report well displays. Laws have been introduced which afford protection to areas both in the north and on the seaboard and the islands, where disafforestation would lead either to denudation of mountain slopes or to the serious results of exposure to wind and storms.

THE question of the management in Finland of communal forests (namely, areas owned collectively by villages, etc.), and of those belonging to the Church and other bodies, has been met by placing the management in its main principles under the Forest Department. Another law has enabled the latter to maintain supervision over privately owned forests. The owners are not permitted to exploit their forests without making arrangements for re-stocking the areas felled; the extent of the fellings made in any one area is also limited by sylvicultural principles. Commissions in each district, consisting of forest officials, are responsible for the supervision, and purchasers of the materials to be felled on areas they buy have to submit to the Commissions an estimate of the amount of material they expect to fell. Thus a check has been instituted against over-felling on one hand, and on the other against leaving unregenerated a felled area. It is said that the private proprietors realise to the full the importance of this law and have readily fallen in with its requirements. Four forest schools are maintained and a research institute. The work undertaken by the professors and assistants in the latter is already becoming well known and will achieve results of lasting importance to Finland. It is a wonderful record for ten years.

THE brilliant success of the Deutsches Museum in Munich, in pushing to its furthest limits the use of motion in adding to the attractiveness of exhibits, has suggested similar developments in other countries. The latest project of the kind is a great scheme for a Museum of Science and Industry in Chicago to "reveal the technical ascent of man". According to Science Service, Washington, D.C., it is proposed to build in Jackson Park a replica in stone of the old Fine Arts building of the World's Exposition of 1893, which is still standing. The new building will cost 5,000,000 dollars, will be fitted for the exhibition of technical and scientific collections, and will possess about 400,000 square feet of floor area. Mr. Julius Rosenwald has endowed the Museum with 3,000,000 dollars, to be spent on exhibits and equipment, but it is surmised that, as in Bavaria, municipalities, the great industries, and private individuals will hasten to add to the completeness of the stock-in-trade of the Museum. Work is to proceed at once, and by 1933 the building ought to be completed and open to the public, although the wise decision has been taken that no attempt will be made to rush the collection and arrangement of exhibits. If the Deutsches

Museum be taken as a standard, the collections may ultimately be worth some 30,000,000 dollars.

THE Report of the meetings of the International Commission on Illumination, held in the United States in September 1928, is a volume of nearly 1300 pages with 18 pages of index. The subjects discussed included street lighting, glare, car headlights, daylight and artificial illumination of works and schools, standards, methods and appliances for photometry, diffusing and signal glasses, colorimetry, vocabulary, units and symbols. The principal decisions are given on pp. 9–20, and some of them are subject to further consideration after reports from the various national committees. The vocabulary is fixed so far as French and English are concerned, but the German, Italian, and Spanish terms have still to be determined. The c.g.s. units are to be used; symbols are to be: F, luminous flux; I, luminous intensity or candle power; E, illumination; B, brightness; R, luminous radiance; and L, quantity of light. The Geneva code for interior illumination is to be retained for the present and statistics for street lighting by modern methods are to be compiled. The proper method of specifying a coloured glass or a diffusing material is indicated, and plans outlined for setting colorimetry on an international scientific basis.

THE Multiple Industrial Fellowship on Portland Cement of the Mellon Institute of Industrial Research and the Eastern Face Brick Manufacturers' Association have recently inaugurated a broad scientific study of the problems of bricklaying. So many factors are involved in the construction of a brick wall that it is necessary to limit the investigation to combinations of variables most likely to occur in actual practice. The project has been under discussion for a considerable period of time; experiments were begun by Dr. F. O. Anderegg, senior industrial fellow at the Mellon Institute, and his assistants only after a satisfactory programme had been worked out. At the present time more than three hundred experimental brick walls or panels have been erected in order to find the most suitable combinations of materials and workmanship. The following problems are being investigated: the rate of absorption and total absorption of moisture by brick; the surface characters of brick; the merits of different cementing materials, ranging from pure lime to pure cement, and of various sands and mortar pigments; the effect of varying the type of backing, both as to material and size of unit; the results of variation in workmanship, including pointing, tapping, and the filling of head-joints; the effect of variation in design, involving a study of coping and parapet construction, of capillary contact, of condensation, and of elasticity; and the behaviour of mortar with reference to the other variables in all types of climatic conditions. All results of these studies are to be published for the benefit of those interested in building construction.

WE record the foundation of a new scientific society, the Gesellschaft für Völkerkunde, which was formally constituted on Oct. 1 with a hundred and sixty members. Though organised on a German-speaking basis, its membership is open to ethnologists of all nationalities. There is an entrance fee of 3 marks and an annual subscription of 5 marks for 1929, and of 3 marks for subsequent years. A quarterly journal entitled *Ethnologische Studien*, of which the first (a double number) has already appeared, is published on behalf of the Society by the Verlag Asia Major, under the editorship of Prof. Fritz Krause, Director of the Ethnological Museum at Leipzig and the first president of the Society. The journal will include ethnological papers in German, English, and French. Members have the privilege of obtaining the journal as well as the *Ethnologische Anzeiger* and *Anthropos* at a reduced price. The address of the Society is, Museum für Völkerkunde, Johannisplatz, Leipzig, C.1. Further particulars may also be obtained from J. H. Driberg, 8 Tavistock Place, W.C.1.

IN the autumn issue of the *Fight against Disease*, the quarterly journal of the Research Defence Society, it is announced that a committee has been formed, with Lord Dawson of Penn as chairman, to perpetuate the memory of Henry Hill Hickman, who died in 1830, and was the first to suggest the use of oral inhalation for the production of anæsthesia during operations. This committee has received sufficient support to enable it to restore Hickman's tombstone and to place a memorial tablet in his native church of Bromfield, Shropshire. It is also hoped to be able to present his portrait to the Royal Society of Medicine and to establish a Hickman memorial medal for work of merit in anæsthesia. Donations may be sent to Dr. Cecil Hughes, 8 Cumberland Mansions, W.1.

THE July number of the *Transactions* of the Mining and Geological Institute of India contains the address of the newly elected president, Mr. F. L. G. Simpson, which was devoted to a review of the mineral production of India for the forty-five years from 1880 compared with that of the rest of the world, the detailed figures upon which his statements were based being given in a series of tables appended to the address. He shows, for example, that within the period named, the weight of coal produced in India has been increased twenty-one times, whereas in Great Britain during the same period it has only been doubled, and in the whole of the rest of the world has been increased three times. The tables referred to form a convenient summary of the mineral production of India over the period with which Mr. Simpson dealt.

THE Right Hon. Lord Cornwallis, chairman of the Kent County Council, has consented to act as president of the forty-first Congress and Health Exhibition of the Royal Sanitary Institute, to be held at Margate on June 21–28, 1930, and the following as presidents of sections: Dr. Andrew Balfour, Section A. (preventive medicine); Sir Henry Maybury, Section B. (engineering and architecture); Lady Howard de Walden, Section C. (maternity and child welfare, including school hygiene); Sir John Moore, Section F. (veterinary hygiene).

MESSRS. Henry Sotheran, Ltd., 43 Piccadilly, W.1, have just circulated another part of their well-known "Price Current of Literature". Its number is 816, and, as usual, it contains very valuable bibliographic notes with reference to many of the works listed. The catalogue is in the front rank of those which reach us, and should certainly be seen by collectors and librarians. The present part gives particulars of nearly 3000 books relating to mathematics, astronomy, physics, and philosophy, including the famous Newton Library.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant in the testing department of an Admiralty establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 17). A junior engineering assistant under the Corporation of Kingston-upon-Hull—The City Engineer, Guildhall, Hull (Dec. 18). An assistant pathologist for work in connexion with the radium 'bomb' treatment of cancer at the Westminster Hospital—The Secretary, Westminster Hospital, Broad Sanctuary, S.W.1 (Dec. 21). A pathologist and bacteriologist at the Cumberland Infirmary, Carlisle—The Secretary, Cumberland Infirmary, Carlisle (Dec. 31). A research fellow in the Department of Glass Technology of the University of Sheffield—The Registrar, The University, Sheffield (Dec. 31). A junior scientific officer in the Air Ministry's Scientific Research Pool, primarily for work at the Royal Aircraft Establishment—The Chief Superintendent, R.A.E., South Farnborough, Hants (Jan. 1, quoting A. 397). A lecturer and organiser in horticulture in the Department of Agriculture, the University, Leeds—The Registrar, The University, Leeds (Jan. 6). A director of the Apia Observatory—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Jan. 25). A chief agricultural officer in Sind, under the Director of Agriculture, Bombay Presidency—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31). A whole-time secretary to the School of Oriental Studies—The Director, School of Oriental Studies, Finsbury Circus, E.C.2 (Mar. 10). A junior assistant under the Directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant agricultural officer under the Kent Agricultural Committee—The Chief Agricultural Officer, Sessions House, Maidstone. A scientific assistant at the Imperial Bureau of Plant Genetics—The Director, Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge.

Our Astronomical Column.

Recent Fireballs.—Mr. W. F. Denning writes : "On the first few nights of the present month brilliant meteors were unusually abundant, and several of them were of startling lustre though without detonations. On Dec. 2 at about 6 P.M. a fireball gave a brilliant display over the south of England. Another followed about four hours later, and a third, which lit up the whole countryside, blazed out just as the morning twilight came on Dec. 3. This object passed from south-east to north-west over England and gave a vivid flash at its disappearance, quite dazzling in its intensity. About half a dozen other fireballs made their appearance between Dec. 2 and 5, and the curious fact in connexion with them was that they apparently had their derivation from different systems. About sixty observations have come to hand descriptive of these objects, and when further data come in it will be possible to compare them and make certain deductions as to the heights, velocities, and directions of the various meteors concerned.

"It is a pity that these fireballs are seldom correctly described. Few people possess a good knowledge of the constellations, and so it happens that casual observers are seldom able to describe a meteor's path in the sky with accuracy."

Commensurabilities of Periods of Planets and Satellites.—L. W. Topham contributes an article on this subject to the *Observatory* for November. He points out that there are very numerous cases in the solar system of close approximations to commensurability. The best known is the 2 to 5 ratio in the periods of Jupiter and Saturn ; also the period of Neptune is nearly twice that of Uranus ; among the satellites there is a relation between I, II, III of Jupiter ; and in those of Saturn the periods of Tethys and Dione are nearly twice those of Mimas and Enceladus. He thinks it is reasonable to conclude that these relationships have some cosmogonic cause. He suggests that the satellites originally existed as clouds of corpuscles round their primaries ; once a condensation was formed in these, other condensations might be set up, by resonance or some similar process, at distances where the period bore some simple relation to that of the first condensation. This would involve the conclusion that the relations originally held exactly, and that the cloud of corpuscles acted as a resisting medium, which was densest near the primary, so that the periods of satellites in this region were relatively more shortened than those of the more distant ones. This suggestion is shown to accord with many of the relations that he has noted in the article.

Auroræ.—*B.A.A. Journal*, Vol. 40, No. 1, contains a report from Mr. W. B. Housman on the observations of auroræ from July 1928 to June 1929. The greater number were observed by Mr. A. Johnson at Haroldswick, Unst, Shetlands. There is stated to have been increased auroral activity during the period, the displays during the magnetic storms of February and March being especially beautiful. For some years the auroræ have been tabulated in the report by the days of the solar rotations reckoned from the zero values of Lo according to Carrington's system. The region of maximum activity has been slowly shifting forward in solar longitude. In 1926–27 the numbers of auroræ in the four solar quadrants were 13, 28, 24, 11 respectively : in 1928–29 they were 18, 23, 26, 8. The region of maximum activity has shifted from the second quadrant to the third. This may mean that the solar regions chiefly concerned in these disturbances have a somewhat slower rotation than the value used by Carrington. In each period the sum of the numbers for the two middle quadrants is about double that of the first and fourth.

Research Items.

Religion of the Torres Straits Islanders.—Dr. Haddon's Frazer Lecture for 1929, "The Religion of a Primitive People", delivered in the University of Liverpool, has now appeared in the *Annals of Archæology and Anthropology*. The Islands fall into three groups, in which culture was practically at the same stage, except in so far as affected by the fertility of the soil. For in the eastern islands the soil was rich enough to support the inhabitants on their garden produce, whereas in the other two groups they had to depend upon fishing. The Islanders are all Western Papuans, but belong to different stocks, two being long-headed, while the third has a broad head. When the white man arrived, the Western Islanders practised totemism, but among the Eastern Islanders it had disappeared. They believed in the continuity of life after death. Certain pantomimic ceremonies connected with this belief were said to have come from the island of Daru, off the coast of New Guinea. In the west the great funeral ceremonies were also the occasion for ceremonies connected with dugong hunting, when the spears, etc., were given fresh power. At these ceremonies the spirits of the dead were believed to be present. The ceremonies of Mer consisted of two main elements: (1) the dramatisation of a legend accounting for various matters connected with funeral ceremonies, and (2) the pantomimic representation of persons recently, and remotely, deceased as denizens of the spirit world. Certain men in Mabuiag were said to have friends in the spirit world and to have a gift of spirit divination. At Mawata a turtle ceremony was celebrated when the turtle were breeding. Various ceremonies in which masked dancers took part ensured good fishing and the ripening of wild fruits. Hero-cults invading the islands afforded an inspiring and consolidating influence previously lacking, but their origin is still obscure.

Abnormal Teeth in Mammals.—A weighty paper on abnormal teeth in certain mammals, and particularly in the rabbit, has been published by the veteran zoologist, Prof. W. C. McIntosh, who has just celebrated his ninety-third birthday (*Trans. Roy. Soc. Edinburgh*, vol. 56, 1929, pt. 2, p. 333). The chief contributions on the subject are summarised, and many new examples of abnormality are described and illustrated in 103 text-figures. The conclusion is reached that, amongst rabbits and other mammals as well, there is a close connexion between abnormalities of the teeth and congenital defect or disease. No case of abnormality in the teeth from injury was met with, and when injury was apparent, as in the distal arch of the mandible of a cat, the disrupted teeth were of normal structure.

Physical Basis of Emanation Therapy.—A recent paper by Prof. Stefan Meyer in the *Sitzungsberichte* of the Academy of Sciences of Vienna (vol. 138, p. 557) deals with the history of radium emanation in the body after it has been administered for therapeutic purposes. Whether it is introduced by way of the lungs or stomach, by far the greater proportion reappears in the air exhaled from the former organs. The content of emanation in the breath varies in a simple way with time, rising to a maximum and then falling off after administration in solution, and falling off continually but not exponentially when it has been introduced diluted with air. The two curves showing the amount of emanation in the breath at various times belong to types which are well known in the theory of the growth and decay of radio-active elements, but in this case the 'half-period' corresponds to transfer of emanation from one part of the body to another. The rate of transfer varies both with the individual and with his condition, but approximately ten minutes are required to evacuate half of the emanation in the lungs by way of the mouth, and about half an hour elapses before half of a charge of emanation in the stomach has been absorbed and passed to the lungs. When emanation is absorbed by the blood from the lungs and again returned to them, the corresponding half-period is much the same as when it is passed from the stomach to the lungs. Other investigations are described in the same paper, which should prove to be a valuable contribution to the theory of radium therapy.

Fisheries Industry in Japan.—Among the most important industries of Japan is that of fishing, some figures regarding which were given by Mr. S. Kato in a paper to the World Engineering Conference held in Japan at the beginning of November (see *Engineering*, Nov. 15, p. 652). Japan is said to have an output of more than 2,000,000 tons of aquatic products, all but twice as big as that of Great Britain and Ireland. The fishing industry in Japan employs more than 1,000,000 people and 350,000 boats, as against the 90,000 men and 20,000 boats employed in Great Britain. The output per head and per boat in Japan is therefore comparatively small, but Mr. Kato gave particulars of the steam and motor fishing boats being developed in Japan by which the industry will be made more efficient. These boats are for bonito fishing, seine fishing, and for crab canning. Bonito fishing is carried on from April to September, and the boats for this are of 100 tons, with Diesel engines of 200 horse-power. The twin-screw seine fishing boats are somewhat smaller, but the floating canneries for crab fishing run from 700 to 4000 tons and are steam vessels. A 3000-ton steamer carries 2000 tons of coal, 20,000 cans, and 800 tons of fresh water. In addition to its crew, it has some 450 fishermen and other workmen. Such a parent ship is accompanied by motor junks and motor boats for the actual fishing. The equipment of a large crab cannery includes crushing, pressing, and drying machinery to make fish oil and fish meal from crab-waste.

Fauna of Pitcher Plants.—The general principle of the insect-trap in pitcher plants is well known, and the organisms ordinarily found living in the fluid of the pitchers are of an exceptional character. Since the fluid contains both proteolytic enzymes and bacteria, it would suggest the occurrence in these organisms of antiproteases to safeguard them from the action of the protease—a fact that has been shown to occur by Hepburn and Jones in the case of a fly larva (*Sarcophaga sarraceniæ*). In Part 7 of Vol. 6 of the *Journal of the Malayan Branch of the Royal Asiatic Society*, Mr. Cedric Dover discusses the pitcher-plant fauna of Singapore Island with particular reference to the resistance of mosquito larvæ to the action of the pitcher fluid. His experiments indicate that many of these larvæ living in such situations contain a potential pepsin resistance, which is developed in the presence of pepsin, and he suggests that a biochemist should study the question more fully. If his conclusions are substantiated, they would seem to indicate that environment is a powerful factor in altering the constitution of an organism. It is noteworthy that Culicid larvæ obtained from stagnant water were only able to survive in the pitcher fluid for a few hours, being almost completely dissolved in three or four days. Among the fauna of these plants,

Batrachian larvæ, fly larvæ, Protozoa, and other organisms are dealt with by different authorities in the groups concerned.

Australian Coleoptera of the Family Dryopidæ.—In the *Australian Zoologist*, Vol. 6, 1929, pp. 50-71 (7 plates) Messrs. H. J. Carter and E. H. Zeck contribute an important paper on the Australian representatives of this family of beetles. These insects mostly frequent clear mountain streams; they are small or minute creatures varying from 1 mm. to 5 mm. in length and very little is known concerning their biology. Although aquatic, they possess no special adaptive organs and are quite unable to swim. They crawl about on the bottom of the water, and the authors record having kept living examples in a vessel of water for five months, without detecting any apparent attempt on the part of the insects to reach the surface. Comparison with the New Zealand fauna reveals the interesting fact that all the Australian species, excepting two, belong to the subfamily Helminæ, which is unknown in New Zealand. The authors list forty-one species, and of these twenty are described as new: two new genera are also diagnosed. The paper is illustrated by exceptionally good figures of these obscure insects, drawn by Mr. E. H. Zeck.

A Revision of the Copepod Genus *Sapphirina*.—Anyone who has had the experience of examining a rich sample of plankton from tropical seas will probably recall his first meeting with a specimen of one of the large species of *Sapphirina* or *Copilia*. These extraordinary copepods may be very large—*S. iris* is 5-7 mm. long—leaf-like creatures so wholly transparent that their presence is perhaps only first realised when puzzling streaks or markings appear above some other object which is being examined. While the beauty of these transparent copepods and the problem of their life-history and probable semi-parasitic relation to *Salpa* make them of unusual general interest, their systematic study is extremely difficult. Lehnhofer (*Wiss. Ergeb. Deutsch. Tiefsee-Exp.*, **22**, Heft 5; 1929) has now given a revision of the whole genus *Sapphirina* which raises some points of special importance. He recognises 10 sharply defined species, but the remainder he finds impossible to treat in the same way. Six of them are bracketed in pairs as the extreme forms of unbroken variation-series; for example, *auronitens-sinuicauda*—while *nigromaculata* Cls. and *scarlata* Giesb. are dealt with as "angenäherten Arten" separable only by small differences in size and doubtfully distinct. Lehnhofer gives in all cases curves of measurements which illustrate clearly the variability of the species. This revision is purely systematic and does not appreciably advance our knowledge of the biology of the genus. Its chief interest lies in the presentation of a good example of the conception of species as groups with extremely wide range of variability, the limits of which are with difficulty definable.

Antarctic Anemones.—Dr. Oscar Carlgren and Dr. T. A. Stephenson describe five new species of Actiniaria from the Australian Antarctic Expedition, 1911–1914 (*Scientific Reports*, vol. 9, Part 2, Series C, Zoology and Botany, April 1929), fourteen species in all being recorded. Embryos were found in the cœlenteric cavity in *Helianthella kerguelensis*, probably having entered the cœlenteron from the brood pouch. In *Bunodactis sulcata*, contrary to Clubb's statement that there are several brood pouches, there was found to be a single brood pouch containing large embryos with much yolk consisting of fat globules. Line drawings in the text illustrate various anatomical features, but there are no figures of the whole animals.

Effect of Genes on Crossing-over.—A detailed analytical study of the influence of particular genes on the crossing-over which takes place in the chromosome to which they belong has been made by Serebrovsky, Ivanova, and Ferry (*Jour. Genetics*, vol. 21, No. 2), using the genes *y* (yellow), a recessive lethal, and a dominant lethal (notch) at the left end of the *X*-chromosome. It is found, in an investigation involving some 60,000 flies, that the introduction of mutations into a chromosome is accompanied by changes in the crossing-over values, especially near the locus of the introduced mutation. The amount of such change is greatest for the notch lethal and least for *y*. This work is a continuation of work which began with the investigation of the effect of the gene 'purple' on crossing-over. The presence of notch lethal increased the cross-overs between eosin and echinus. Similarly, the recessive lethal increased the crossing-over in loci near it, but with yellow the result was not so clear. The results are explained in terms of the presence-absence hypothesis. It is supposed that the appearance of a recessive gene actually shortens the chromosome, corresponding to a slight deficiency, and leads to asymmetry, reducing the amount of crossing-over. The introduction of genes into the chromosome mate will tend to lessen this asymmetry and so increase the amount of crossing-over.

Studies on *Ranunculus*.—Mixed sexual forms of flowers in *Ranunculus* have been recorded for many years and are now being intensively studied by Messrs. Marsden-Jones and Turrill. In a recent paper (*Jour. Genetics*, vol. 21, No. 2) they record preliminary data regarding crosses between the various sex-forms, but thus far no consistent interpretation of the results appears. Observations are also made on the yellow, lemon, and pale forms of *R. acris* and *R. bulbosus*. These colours are independent of the sex expression, and it is found that plants of all three colours can be heterozygous for colour. In a field in Warwickshire the distribution of the pale flowered individuals indicates that they have spread from a single mutational ancestor. Mr. R. O. Whyte, who is co-operating in a cytological study of the 'intersexes', has obtained some interesting results. Male, female, and intermediate forms are found to differ in the length of the interval between the critical stages of pollen and embryo sac formation. This is associated with differences in the functional activity of the tapetum, which in turn may be determined by differences in the vascular supply to the different types of flowers. In the form with 'female' flowers, the reduction divisions in anthers and ovules are coincident, whereas in normal hermaphrodite plants the anther meiosis is much earlier, and the tapetum fully functional. Another interesting fact brought out by these and other studies is that whereas the chromosome number for normal *R. acris* is 14 in England, Sweden, and New York, at Tzarskoe Selo 12 were found. The studies of Sorokin in America indicate instability in other characters associated with gynodimorphism and variations in the chromosome content of the nuclei.

Fossil Vertebrates of North America.—The Carnegie Institution of Washington has produced Volume I of the "Second Bibliography and Catalogue of the Fossil Vertebrata of North America" (*Publication* No. 390), by Dr. O. P. Hay. There are 513 pages of bibliography, and an examination of this section makes the title of the work appear a little misleading, seeing that the entries cover a much wider range than American vertebrates alone. There are, for example, more than seven columns devoted to Huxley's papers, or, to come to modern times, some ten columns to

Abel's works, which again cover a wide field of palæontological investigation. Of this discrepancy between title and contents one can scarcely complain, seeing that the larger the bibliography is the more useful it is likely to prove. The second section consists of 400 pages devoted to a classification of extinct vertebrates from fishes as far as the amphibia, a supplement and index. A full cross reference to authors is given under each species mentioned in the catalogue. Errors in a compilation of this kind must be expected, but these are far outweighed by the obvious value of the work to students, whose time in searching out references will be much saved, and they owe a debt of gratitude to Dr. Hay for this great and laborious work. Its continuation, which is promised, will be welcomed.

Survey by Air Photographs.—The methods of surveying by the use of air photographs was the subject of a recent *Professional Paper* of the Air Survey Committee of the War Office. A continuation and amplification of that paper now appears in "Extensions of the 'Arundel' Method", by Captain M. Hotine (*Professional Paper*, No. 6, 4*s*. net.). The 'Arundel' method was designed for areas in which differences in ground height are less than one-tenth of the flying height. Among other aspects of the problem, this paper deals with the extension of the method of survey to mountainous areas. For this purpose an experimental survey was made of Glen Clova in Forfarshire (Angus), and the result is published on a scale of 1 to 20,000 with a contour interval of 50 feet. It was found necessary to set the time interval of exposure for overlap by observation on the high ground, for the normal overlaps, forward and lateral, are otherwise shortened or excised for considerable elevations. The lighting of steep slopes involves consideration in time of flying, the eastern and western slopes being best photographed in the morning and evening respectively. Valley mists and vertical air currents were minor difficulties and the pilot had difficulty in maintaining a constant height over this type of country. The paper goes on to consider contouring and plotting.

Superconductivity in a Compound.—A fresh case of superconductivity is described by Prof. W. Meissner in a communication from the Physikalisch-Technische Reichsanstalt appearing in the issue of the *Zeitschrift für Physik* for Nov. 9. When copper wire is heated in the vapour of sulphur, it passes into copper sulphide (CuS) without change in geometrical form. The resulting material has a specific resistance of 4×10^{-5} at 0° C., and—taking this value as a convenient unit—a resistance of 0·30 at the temperature of liquid air (86° absolute), and one of 0·02 in boiling hydrogen (20° abs.). At the normal boiling point of helium (4° abs.) the resistance has fallen further, to 0·004, but below this temperature it remains almost constant down to 1·66° absolute, when a sudden drop takes place to an immeasurably small quantity, which then persists for temperatures below about 1·55°. The occurrence of superconductivity in a compound is in itself important, and it is also remarkable that the residual constant resistance found immediately before the superconducting state is attained has the small value which has hitherto always been found to be associated with very pure metals.

Structure of Complex Compounds.—The structures of complex polyacids is now generally explained by a theory due to Miolati and Rosenheim, based on Werner's theory. Whilst this enables a considerable amount of order to be brought into the chemistry of these compounds, it is not always satisfactory and is sometimes rather arbitrary. In the April and October numbers of the *Journal of the American Chemical Society*, L. Pauling has put forward an alternative method which seems to offer possibilities in those cases where the structure may be regarded as formed of anions and cations. The method is somewhat on the lines of that used by W. L. Bragg in elucidating the structure of silicates and depends on the use of crystal data. In considering the tungstosilicate ion, for example, it is pointed out that the crystal radius of the ion W^{+6} is such that six oxygen ions could be grouped about it at corners of an octahedron. Stable complexes can then be formed by arranging WO_6 octahedra in such a way that they share corners with each other. A number of subsidiary principles enter, for which the originals must be consulted.

Optical Activity of Diphenyl Derivatives.—Prof. Kenner's discovery of optical activity among derivatives of diphenic acid has led to the adoption of the interesting suggestion of W. H. Mills that the presence of substituents near to the junction of the two aromatic nuclei produces mechanical interference of free rotation of the nuclei about their common link. This view has been supported by the work of Meisenheimer and, in the November issue of the *Berichte der deutschen chemischen Gesellschaft*, further experimental evidence in support of it is brought forward by F. Pufahl, who describes some hitherto unknown derivatives, which contain substituents in the 5·5′ positions. These resemble the 4·4′ derivatives in being optically inactive and in giving rise to anhydrides. Thus the resolution of derivatives into optical isomerides appears to be confined to such as contain substituents in the 6·0 positions.

Rates of Saponification of Oils.—Very little work has been done on the rates of saponification of oils and of pure triglycerides by aqueous alkali, and the experiments described by McBain, Humphreys, and Kawakami in the October number of the *Journal of the Chemical Society*, which add considerably to the information on this subject, are therefore of interest. A large number of materials, including commercial oils and fats, were used, and the rates of saponification by soda were measured under strictly comparable conditions. All reagents were kept in large excess except the dilute hydroxide, the rate of disappearance of which was followed by means of the hydrogen electrode and was found to be unimolecular so far as the hydroxyl ion is concerned. A soap was used as a constant emulsifying agent and the liquid was rapidly stirred. Castor oil was most rapidly saponified, and colza oil most slowly. Lard is rather rapidly saponified, but olive oil slowly, this oil being next to colza oil. Two specimens of lard showed rather different rates. The range of time is great, being 200-fold for the extreme cases. This is due, according to the authors, to the different ease and degree of emulsification of the various oils. In saponification, as in other related fields, reactions are supposed to take place at the interface between oil and water and not in either phase, and hence the primary factor is the development of this interface, which is favoured by emulsifying agents and by the degree of readiness of the oil to be emulsified. Free fatty acid in the oil increases the readiness to emulsify. Apart from castor oil, there is a relation between iodine value and rate of saponification, unsaturated oils being slower than saturated. Multiple double bonds in the carbon chain seem to inhibit saponification more than single ones such as oleate radicals. There is no relation between the emulsifying power of a soap and the emulsifiability of the corresponding oil.

Water Power Development in Canada and Malaya.

A NOTABLE step in the development of Canadian water power resources has just been taken in the inauguration by His Excellency the Governor-General of constructional operations for the power house which is to be erected by the Beauharnois Power Corporation just above the shores of Lake St. Louis, near the village of Beauharnois.

The scheme includes a canal for the diversion of the water of the St. Lawrence River for power production and also for navigation purposes. This canal, work on which has been commenced by the formation, simultaneously, of two dykes at Valleyfield, when completed, will have a depth of 30 ft., which will be sufficient to accommodate the largest vessels now navigating the Great Lakes. The power station will utilise the 83 ft. fall in the St. Lawrence River between Lakes St. Francis and St. Louis, which lie just above the city of Montreal. It is claimed that it will ultimately become the largest hydro-electric generating station in the world.

The present programme is to provide a development of 200,000 horse-power by Oct. 1, 1932, but it will be possible to increase this figure, which is the minimum limit, to 350,000 h.p. by the same date, if so required, and a primary objective of 500,000 h.p. has been decided upon by the executive officials of the organisation. The extent of ultimate development will depend on the quantity of water permitted to be diverted from the St. Lawrence. The company has, at present, been conceded the right to divert 40,000 cusec. (cu. ft. per sec.). Across the river on the left bank, the Cedar Rapids installation of the Montreal Light, Heat, and Power Consolidated is generating 200,000 h.p. from a head of only 32 ft. If this water were diverted through the Beauharnois Canal, it is claimed that there would be a threefold economy and that nearly 600,000 h.p. could be developed. It is stated, furthermore, that an ultimate development of two million h.p. would be possible if the whole of the water in the St. Lawrence channels were diverted through the canal.

In the meantime, the project in hand involves the expenditure of 16,000,000 dollars on the canal and a total expenditure estimated at 65,000,000 dollars for the installation of 500,000 h.p. During the next three years the countryside on the south bank of the St. Lawrence from Beauharnois to Valleyfield will be the scene of constructional operations of considerable magnitude among enterprises in the history of Canadian water power development.

In the *Metropolitan Vickers Gazette* for October there is an interesting account of the Perak River hydro-electric scheme which is being erected in the Federated Malay States and will be opened next year. It illustrates some of the difficulties that have to be overcome in setting up one of the latest products of engineering skill in the Far East. The photographs shown of 66-kilovolt overhead wires and substations are very similar to corresponding systems in Europe.

The main supply station is a hydro-electric one situated on the west bank of the Perak River, sixty miles north of Malim Nawar. It is the main supply station but it works in parallel with a steam station. All the outdoor substation structures are flood-lighted at night. Double parabolic reflector type projector lamps are fitted on the top of steel poles fifteen feet high. The only objection to the lighting is the fatal attraction it has for the many insects with which the country abounds. The crowds of flying beetles round these lamps sometimes alarm the superstitious watchmen. The working of the whole system is almost entirely automatic. The Cambridge Instrument Co. has supplied the temperature indicators and alarm equipment for the whole scheme. Thermocouples are provided, the temperature of the cold junction being kept constant by a thermostat. Chinese, Indian, and Malay native workmen were employed. The atmosphere compelled attention to all flesh wounds, but the iodine treatment caused the natives to flinch, although they would cheerfully cauterise a wound with a lighted match.

Conversion Tables for Galactic Co-ordinates.

PROF. PIO EMANUELLI, secretary of the Vatican Observatory, has just published an extensive table for the conversion of Right Ascension and Declination into galactic co-ordinates, which forms an appendix to vol. 14 of the *Publications* of the Observatory.

The author gives a summary of the various positions of the north galactic pole as determined by different authorities, and decided to adopt Newcomb's value (slightly modified), rather than a combination of different values. The adopted position of the pole for the equinox of 1900 is R.A. 191·1°, North Decl. 26·8°. It is within half a degree of Heis's position.

In reducing to galactic co-ordinates, a zero of galactic longitude must be selected. Most authorities up to the present have adopted the intersection of the galactic equator with the equator of 1900. This is open to objection since the equator changes greatly owing to precession, and the equator of 1900 would be very inconvenient in distant epochs in the future. Dr. Innes suggested using the galactic longitude of the solar apex, which is assumed to be R.A. 270°, North Decl. 30°, for the equinox of 1900. This is the value adopted in the tables, although the author points out that the International Astronomical Union decided both in 1925 and in 1928 that the star Alpha Cygni should be taken as the zero of longitude. It has the double advantage of being close to the galactic equator (distance one degree) and of having almost insensible proper motion. Further, it is a definite and brilliant point, whereas the solar apex is invisible, and is uncertain by a few degrees; moreover, it is 22° from the galactic equator. However, the table can easily be adapted to give longitudes from Alpha Cygni; it is only necessary to *subtract* (not *add*, as erroneously stated both on p. xv and p. xix) the quantity 27·9°; another erratum in the tables is that this correction is stated to vary with the epoch; it is constant and independent of precession. The correction to reduce the longitude to the intersection of the galaxy with the equator of 1900 is +23·6°; with the equator of 2050 it is +23·8°.

The tables give l, b, the galactic longitude and latitude, to the nearest tenth of a degree for every ten minutes of time in R.A. and every degree of declination. There is a supplementary table for every minute of R.A. in the neighbourhood of the galactic poles. Attention should be paid to the short list of errata at the end of the tables.

Rev. J. G. Hagen, S.J., the Director of the Observatory, contributes a preface, in which he notes that the tables will be applied to obtain the galactic co-ordinates of the nebulæ observed by him; they will be mapped on an equal-area projection.

Rice Grass and Land Reclamation.

THE economic possibilities of *Spartina Townsendii*, commonly known as rice grass, are described in an illustrated booklet issued by the Ministry of Agriculture (Miscellaneous Publications, No. 66, price 8*d*.). The grass, a tall rhizomous, deep rooting plant, occurs on maritime muds and was first recorded in England on the Southampton salt marshes in 1870. Its spread along the south coast has been very rapid, from fifteen to twenty years being usually sufficient for the conversion of waste land into continuous meadow. Propagation is effected by seed or fragments of runners.

The value of *Spartina* lies in the fact that it is particularly suitable for land reclamation and protection, and at the same time can be used for feeding to stock. The grass, owing to its extensive underground system, has the property of binding the mud in which it grows, and with the help of silting brings about a rise in the level of the land. Valueless mud flats can thus be brought into use, and sea walls or banks protected from erosion by consolidation of the mud in front. As food for stock, *Spartina* offers great possibilities. All farm animals eat it readily, whether cut fresh or as hay, and since it remains on its root throughout the winter, it forms a convenient reserve food.

The composition of *Spartina*, apart from mineral matter, is somewhat similar to good meadow hay, and preliminary feeding trials showed it to be fully digestible to sheep.

Experiments are in progress at the East Anglian Institute of Agriculture to determine the best way of introducing and growing *Spartina*, particularly with the view of feeding it to stock. The question as to whether it can be used most profitably fresh, or as hay or silage, are among other problems under investigation.

Although sufficient time has not yet elapsed for any definite results to have been obtained from the experimental plantings in Essex, the growth appears entirely satisfactory, and there is every prospect of its proving valuable to the farmer. In other countries of temperate climate *Spartina* also grows readily. The natural spread of the plant along the coast of France has been most impressive, and cuttings exported from Poole Harbour for experimental planting on the muds of Holland have rapidly become established. The plant seems likely to prove of inestimable value in the solution of the ever-present problem of land reclamation and protection in the latter country.

A feature that must not be overlooked when plans for the introduction of *Spartina* to an estuary are contemplated, is the inevitable reduction in the flow of tidal water when the plant becomes established. In certain circumstances this might adversely affect navigation or land drainage. Apart from this, however, the economic possibilities of *Spartina* appear very promising.

University and Educational Intelligence.

CAMBRIDGE.—C. F. A. Pantin, of Trinity and Christ's Colleges, has been appointed University lecturer in zoology for three years. J. E. E. Craster, of Downing College, has been appointed University lecturer in geography for three years.

Dr. F. P. Bowden has been elected into a fellowship at Gonville and Caius College.

RESEARCH scholarships for the encouragement of work in sanitary science are being offered by the Grocers Company. The scholarships are of the value of £300 a year, plus an allowance for apparatus and other expenses, and are tenable for one year, with possibility of renewal for two or three years. Applications must be received by the Clerk to the Grocers Company, Grocers Hall, E.C.2, before the end of April next.

BIRKBECK College, which has since 1920 enjoyed the status of a school of the University of London, has sent us with its Calendar for 1929–30 the first annual Haldane memorial lecture, delivered last May by Lord Justice Sankey. The governors of the College resolved, on the death of Lord Haldane, who had been its president from 1919, to institute this annual memorial lecture in his honour, and the first of the series is devoted, appropriately, to an estimate of his work as lawyer, statesman, and philosopher, and the meaning, object, and value of the adult education movement which he did so much to foster.

THE annual conference of the Geographical Association will be held on Jan. 2–6 at the London School of Economics, Houghton Street, London, W.C.2, under the presidency of Sir Henry Lyons, who will deliver his address on the first day of the meeting. The programme includes discussions on the physical basis of geography in independent schools, to be opened by Mr. B. B. Dickinson, geography and the training of teachers, to be opened by Mr. T. Herdman, and lectures by Mr. H. E. Raynes on the mortality of Europeans in equatorial Africa, by Colonel H. L. Crosthwait on air survey, by Sir John Russell on agricultural developments in South Africa, and on national parks by Dr. Vaughan Cornish. The week-end will be devoted to an excursion to Norwich. The president-elect of the Association is Mr. B. B. Dickinson. On Jan. 2–4, a publishers' exhibition of books, maps, and geographical appliances will be open for the use of those attending the conference.

UNIVERSITY College, London, announces in its Calendar for the current session numerous post-graduate courses of lectures (open to students of other London colleges under the inter-collegiate scheme) and facilities for research in its faculties of arts, laws, science, medical sciences, and engineering, and in the Bartlett School of Architecture. Among recently developed departments of work in the College is that connected with the Ramsay Laboratory of Chemical Engineering. Here the bulk of the work will be of a research character and directed towards the elucidation of industrial problems. The Calendar contains a list, running to 28 pages, of original papers published during the past year in the various departments, the most prolific of which is the department of physiology and bio-chemistry, which was responsible for fifty-three original papers. Among voluminous appendices appears Sir Gregory Foster's annual report for 1928–29, a year noteworthy in the history alike of the College and the University as that in which statutes giving effect to the new constitution of the University were sealed and the new University Court and Collegiate Council were established, and the Calendar contains, very appropriately, an eloquent tribute to Lord Haldane's services to University education in general and the University of London in particular. "No man of his own or any other generation", said Sir Walter Morley Fletcher in recounting those services in the course of his address to the assembly of the faculties of July 4, "has done more to promote the growth of University education in this country." University College, having enjoyed for twenty-five years the leadership of Sir Gregory Foster, will shortly welcome his successor, Mr. Allen Mawer, who is to take over its administration as Provost on Jan. 1, 1930.

Calendar of Patent Records.

December 14, 1688.—On Dec. 14, 1688, Abraham Thevart was granted a privilege for 30 years by Louis XIV "de faire seul, à l'exclusion de tous autres, de fabriquer où bon leur semblera, des glaces de soixante pouces de haut, sur quarante pouces de large, et de toutes autres hauteurs et largeurs au-dessus, . . . et pour cet effet se servir seulement des machines que ledit Thevart a inventées", on condition that a description of the process be presented within three months. Thevart set up his factory first in the Faubourg St. Antoine and later at St. Gobain, where large sheets of glass were cast in 1693, the first four pieces being presented to the king. In England the first large glass sheets were manufactured by the Company of British Cast Plate Manufacturers, formed in 1773, in a factory at St. Helens, Lancashire.

December 15, 1883.—It was Gottlieb Daimler who first realised the importance of high piston speeds for the internal combustion engine, and the motor-car industry really dates from his patent, which was applied for in Germany on Dec. 15, 1883. His first engine—a four-stroke engine running on benzene—was built into a bicycle, which was driven for the first time in November 1886 in the streets of Cannstatt.

December 16, 1835.—Henry Booth, one of the chief promoters of the Liverpool and Manchester Railway, and the first secretary of the Company, invented the common screw-coupling for railways. It was adopted by his company and has continued in use to the present day. His patent, dated Dec. 16, 1835, for "an improved method of attaching railway carriages together for the purpose of obtaining steadiness and smoothness of motion", probably was for this invention, but no specification was enrolled and the patent became void within two months of the grant.

December 20, 1822.—The first 'eversharp' pencil was patented in England by John Isaac Hawkins and Sampson Mordan on Dec. 20, 1822, with the title "Improvements on pencil holders for the purpose of facilitating writing and drawing by rendering the frequent cutting of the points unnecessary." The projection of the lead was governed by screw mechanism within the pencil holder.

December 21, 1612.—The patent granted to Joseph Usher, Warner Rich, and Godfrey Devette, on Dec. 21, 1612, for a new engine for supplying water to cities and towns and private houses, etc., contains a provision that a model of the invention is to be supplied within one month from the date of the grant, and furnishes an early example of the official requirement of a description of the invention as a condition of the grant. Sir Hugh Myddleton's patent for the supply of water to London was granted in the previous May, and this may have been the cause of the insertion of the proviso in the later grant.

December 21, 1736.—Jonathan Hull's patent for his "machine for carrying vessels or ships out of or into any harbour, port, or river, against wind or tide or in a calm", was granted on Dec. 21, 1736. Hull proposed to use a Newcomen engine to propel a tug-boat, by means of a stern paddle wheel operated through rope gear and pawl and ratchet mechanism. His experiments were presumably not successful, but he published in the following year a book describing the invention, which may have stimulated the later inventors.

December 21, 1802.—"Tatham's Clumps", which were interlocking bricks for building circular structures such as wells, columns, pipes, etc., were patented by William Tatham and others on Dec. 21, 1802. The bricks were made at the works of Scott and Clarkson, at Hackney.

Societies and Academies.

LONDON.

Royal Society, Dec. 5.—**F. A. B. Ward, C. E. Wynn-Williams, and H. M. Cave:** The rate of emission of alpha-particles from radium. A new type of electrical counter was used in which the whole of the amplification is produced by triode valves. The amplification was linear, so that the counting of α-rays was undisturbed by the presence of β-rays. About 500 particles per minute could be counted. The rate of emission from radium determined by counting about 10^5 α-particles was $3{\cdot}66 \times 10^{10}$ α-particles per sec. per gm. of radium.—**E. J. Williams and F. R. Terroux:** Investigation of the passage of fast beta-particles through gases. The primary ionisation for beta-particles of 0·5-0·9 of the velocity of light, determined in the Wilson cloud chamber, appears to approach limits of 22 ions per cm. in oxygen, and 5 ions per cm. in hydrogen. Variation with velocity differs appreciably from that predicted on classical theory. From the frequency of branch-tracks, the magnetic moment of an electron seems considerably less than a Bohr magneton. Momentum appears to be conserved in branch collisions.—**R. J. C. Howland:** On the stresses in the neighbourhood of a circular hole in a strip under tension. The problem is solved by successive approximation for the case in which the stress-system is symmetrical both about axis of strip and about perpendicular diameter of hole. General formulæ are given expressing each approximation in terms of the preceding. The coefficients of the transformation depend upon transcendental integrals which are estimated numerically and coefficients are then tabulated. When the ratio of diameter of hole to diameter of strip does not exceed 0·5, greatest stress at boundary of hole is nearly $4\frac{1}{3}$ times tension at infinity. On the edge, tension rises from a minimum of less than $\frac{3}{4}$ of applied tension at point nearest to hole, to maxima, not much less than twice applied tension, at about one-third of width of strip on either side of central section. On the axis, disturbance due to hole becomes inappreciable at a distance from centre of hole equal to about $1\frac{1}{2}$ times width of strip.

Geological Society, Nov. 20.—**D. Williams:** The geology of the country between Nant Peris and Nant Ffrancon (Snowdonia) The general stratigraphical succession is given. The topmost Cambrian beds, the Ffestiniog or *Lingula* Grits, are of shallow-water origin. They are faulted against blue-black slates, probably of Lower Llanvirn age. Upwards, the slates pass into the paler Llandeilo slates with *Glyptograptus teretiusculus*, at the top of which occur the Talgau lavas apparently belonging to the Glyder Fach-Capel Curig volcanic suite. These earliest flows are notably sodic. The Snowdon Volcanic Suite is essentially composed of potash-rhyolites and rhyolite-tuffs, succeeded, near the Devil's Kitchen, by pumice-tuffs and flows of andesitic or basaltic character. The Upper Rhyolitic Series of Snowdon itself is here absent. Two large acid plutonic masses, Moel Perfedd and Bwlch-y-Cywion, are believed to represent the denuded plugs of the vents from which the Lower Rhyolitic Series was extruded. Both the folding and the cleavage, which strike approximately north-east and south-west, are attributed to Caledonian earth-movements, the cleavage following closely upon the folding, but preceding the faulting. 'Cleavage-fans' are conspicuous, two 'synclines' being separated by an 'anticline'. There appears to be no evidence in this area of the post-cleavage thrusting observable on Snowdon.—**Beeby Thompson:** The Upper Estuarine series of Northamptonshire and

northern Oxfordshire. J. W. Judd, in 1867, gave the name 'Upper Estuarine Series' to a series of variable beds, largely variegated clays containing abundance of vegetable matter of probably freshwater origin, interspersed with brackish-water beds and with distinctly marine beds. The author in 1909 recognised an 'Upper Estuarine Limestone', commonly a water-bearing bed in the midst of the series. This bed divides the series into three parts, on which additional information is given. In northern Oxfordshire, between certain inferior oolite limestones or white sands (the time-equivalents of the Lincolnshire limestone ?), or ferruginous sands (the equivalents of the variable beds of the Northampton sand or even of the ironstone series) below, and the great oolite limestone above, occurs a series of beds which in various parts physically, and in others palæontologically, agree, as does the complete set in sequential position, with the Upper Estuarine Series of Northamptonshire. The Northamptonshire and Oxfordshire sections on this geological horizon are thus more definitely correlated. In Part 2 of the paper it is shown how the extended classification of beds can be used for identifying unconformities due to earth-movements developed at different times.

Linnean Society, Nov. 21.—**M. J. Godfery**: The pollination of *Cephalanthera*. The three British species can be cross-pollinated by insects, though there are no viscid glands to attach the pollinia. An insect retreating from the flower becomes smeared with the viscid secretion of the stigma, which then picks up the pollinia projecting from the anther.—**E. B. Poulton**: Recent observations on snake-like caterpillars which throw light on a statement in H. W. Bates's classical paper on mimicry. Bates was probably referring to a Sphingid larva which deceived him by the reduction of the caudal horn to a mere hump in the final stage. The two larvæ, *Leucorhampha triptolemus* Cram. and *L. ornatus* Rothsch., behave exactly as Bates described, and bear their terrifying eye-like marks on the ventral surface.—**S. K. Montgomery**: Report on the Crustacea Brachyura of the Percy Sladen Trust Expedition to the Abrolhos Islands under the leadership of Prof. W. J. Dakin, D.Sc., F.L.S., in 1913; along with other crabs from Western Australia. Of 57 species and varieties in the collection, there are 8 species and 4 varieties described as new; and a new genus is suggested to contain one of these, along with *Grapsus inornatus* (Hess) and *Brachynotus octodentatus* (Milne-Edwards). The Brachyuran fauna of the Abrolhos Islands is more nearly related to that of the north of Australia than to that of the south and south-west. The Ninety Mile Beach, north of Broome, has divided the Brachyura into a northern and a north-western group. The relative absence of the Oxystomes both from the north-western and the southern groups is noted. The Brachyuran fauna of Australia as a whole, and of the south of Australia in particular, varies considerably from the general homogeneity of the Indo-Pacific.

Physical Society, Nov. 22.—**D. P. Dalzell**: Heaviside's operational method. The method of treatment incorporates the views of the late T. J. I'A. Bromwich with those of J. R. Carson, and is identical with that advocated by Van der Pol. It involves unrestricted use of complex integration as employed by Bromwich, and thus avoids such uncertainties as arise from the use of operators denoted by incomplete symbols. The theory of integration provides a complete explanation of all the aspects of Heaviside's method of solving differential equations.—**E. T. Hanson**: The dynamical theory of resonators. The theory of the small resonator with neck communicating with the open air depends upon the assumption that the air within the neck may be treated as an imcompressible fluid. The theory is extended to include generally necks of variable cross section.—**E. C. Atkinson**: Escapement errors of pendulum clock. Prof. Sampson's theory of maintenance is applied to find equations for the errors of rate caused by changes in intensity and limits of the impulse and in friction of moving parts of the impulse mechanism. For the Cottingham clock, rigidity of the stops limiting the impulse is the most important point in design. The equations are also given for the dead beat escapement and show that working conditions which are good so far as friction is concerned are bad for barometric changes. The method used for computing 'remote' error in these cases must be modified when the inertia of the impulse mechanism is appreciable as in the Shortt clock.

DUBLIN.

Royal Irish Academy, Nov. 11.—**J. J. Nolan** and **J. G. O'Keeffe**: The ions produced by discharge at liquid surfaces. Chattock's method is used to determine the mobilities of ions produced in discharges at water and alcohol surfaces. The ions are of the same character as those produced by discharge at metal points or by the ionising radiations. The observation of Tyndall and Phillips, that in air saturated with *n*-butyl and *n*-amyl alcohols the mobility of the positive ion is greater than that of the negative, is confirmed.—**Miss A. L. Massy**: The Mollusca of the Irish Atlantic Slope. The Mollusca (other than the Cephalopoda, Amphineura, Pteropoda, and Heteropoda and Nudibranchia) taken by the Fisheries Branch of the Department of Agriculture, Dublin, on the west of Ireland since the year 1900: the area covered is between lat. 49° N. and lat. 56° N. Records east of the Fastnet Light, Co. Cork, have been excluded and the western boundary is the 1500 fathom line. Many rare deep-water species have been captured. 313 species are enumerated, and under the fossil distribution will be found many records from Irish and Scandinavian sources not very accessible to students of the group.

PARIS.

Academy of Sciences, Nov. 4.—**Eugène Slutzky**: The extension of the theory of periodograms to series of dependent quantities.—**B. Demtchenko**: An inverse problem to the problem of Dirichlet.—**Henri Cartan**: The zeros of the linear combinations of p given integral functions.—**Georges Valiron**: Meromorph algebroid functions.—**A. Markoff, jun.**: Nearly periodic movements.—**E. G. Barrillon**: Concerning discs rotating in a fluid.—**R. de Mallemann**: The calculation of the atomic frequencies in solids. The formula of Lindemann rests on the hypothesis that at the melting-point the amplitude of the atomic vibrations should be equal to the mean distance of the atoms. From the author's calculations this is inexact, and the ratio is smaller than unity, 0·06 for aluminium, silver, gold, platinum, copper, iron, nickel, cobalt; 0·08 for the alkaline metals; and 0·04 for liquid mercury. This ratio is practically equal to the product of the coefficient of expansion and the absolute temperature of fusion.—**Albert Turpain** and **Michel Durepaire**: The electric charges developed in certain amorphous dielectrics under the action of pressure. This phenomenon is exhibited by ebonite, paraffin, glass, and especially by crêpe rubber. A diagram is given showing the electrical charges produced in rubber as a function of the pressure.—**E. Pierret**: A new mode of receiving ultra-short [electric] waves, 10 cm.–18 cm. wave-length.—**L.**

Jolland: The conductivity of solid salts at high temperatures.—G. Bruhat and R. Legris: The absorption of aqueous solutions of tartaric acid and of alkaline tartrates.—P. Vaillant: The absorption spectrum of cobalt chloride and its variations. Six solutions of cobalt chloride were studied, the first pair in water varying in concentration, the other four at the same concentration but in varying solvents. Analysis of the results showed that the ion Co^{++} acted throughout as the only absorbing agent, its activity varying with the concentration and with that of the other ions in the solution.—R. Gindre: A phenomenon of atmospheric optics.—Jean Thibaud and Jean J. Trillat: The diffraction of the X-rays in various substances, principally in liquids.—A. Grumbach and S. Schlivitch: The rôle of the atmospheric oxygen in photoelectric batteries with coloured liquids.—A. Boutaric and Mlle. M. Dupin: The slow evolution of mixtures of colloidal solutions resembling anaphylactic effects.—M. Bourguel and Mlle. V. Gredy: The selective action of a hydrogen catalyst. A study of the addition of hydrogen to phenyl-acetylene with colloidal palladium as the catalyst. The determination of the velocities of hydrogenation shows that the reaction takes place in two distinct stages, first the production of phenylethylene and then the formation of the saturated hydrocarbon. The reaction velocities of these two stages differ considerably, and if, after the complete conversion into phenylethylene, the reaction velocity for the second stage is reached, the fresh addition of phenylacetylene to the mixture re-establishes the velocity of the first stage.—Albert Portevin and Pierre Chévenard: The influence of the fineness of structure at the time of annealing grey cast irons.—Dumanois and Mondain-Monval: The direct oxidation of hydrocarbons by the air. A closed bomb containing pentane and air under pressure was maintained at various temperatures between 80° C. and 230° C., portions being withdrawn from time to time and tested for carbon dioxide and for aldehydes. It was shown that some degrees below the temperature of spontaneous inflammation, chemical reactions were taking place in the mixture, heat being disengaged and carbon dioxide and aldehydes being formed. Similar results were obtained when the pentane was replaced by other hydrocarbons (hexane, heptane, octane).—G. Dupont and J. Lévy: The auto-oxidation of abietic acid.—Georges Darzens: The condensation of the chloride of dimethylacrylic acid with benzene: dimethylvinylphenyl ketone as a product of the reaction. This reaction does not give the hydrindone which might be expected, the reaction stopping at the first stage, dimethylvinylphenyl ketone, $C_6H_5 . CO . CH=C(CH_3)_2$.—Maurice Nicloux: The micro-estimation of carbon and the estimation of this element in arable soil. A modification of the method described in earlier communications avoiding the use of a microbalance.—C. P. Nicolesco: The discovery of the Cenomanian in the valley of Ganzeville (Seine Inferieure).—Pierre Lesage: Continuation of researches on precocity and its heredity in *Lepidium sativum*.—M. Bridel and J. Rabaté: Variations in the composition of new branches of *Amelanchier vulgaris*. Determinations of the ameliaroside in the fresh branches showed large variations from month to month: no reasons for this variation can be assigned at present.—Et. Föex and Et. Rosella: Contributions to our knowledge of the *Piétin* of wheat.—J. Magrou, Mme. M. Magrou, and P. Reiss: Action at a distance of various factors on the development of the egg of the sea-urchin.—Mlle. Choucroun: The hypothesis of mitogenetic radiation.—A. Blanchetière: The pepsin and trypsin hydrolyses of the gliadin of wheat in their relation with the formation of the diacipiperazines.

BRUSSELS.

Royal Academy of Belgium, April 13.—Th. De Donder: The invariantive theory of the calculus of variations (4).—Oct. Dony: (1) An experimental contribution to the study of heating and of electric furnaces. The author replaces platinum, or refractory alloys such as nichrome, with soft iron of large cross section, up to 5 mm. diameter for cylindrical wires. The currents employed were of the order of 200 amperes, and with suitable heat insulation, temperatures of 1150°-1200° C. could be maintained for long periods. Examples of laboratory applications of these furnaces are given.—(2) The reduction of zinc oxide by gaseous carbon monoxide at atmospheric pressure and at high pressures. The electric furnace described above has been applied to the reduction of zinc oxide in carbon monoxide at 1100°-1300° C.—D. Pompeiu: An integral property of functions of two real variables.—Jean P. Bosquet: Some fundamental formulæ of the invariantive theory of the calculus of variations.—Louis van den Berghe: Observations on the sense of smell and on the mechanism of the olfactory currents in some Teleostians. The detailed study of five species, with ten illustrations, is given. The sense of smell varies greatly in different forms; *Blennius pholis* finds its prey both by sight and by smell, whereas *Cottus bubalis* does not use the sense of smell.—Maury: Report of the geodesic section of the Institut Cartographique Militaire.—Lucien Godeaux: The fundamental curves of birational transformations of space.—André Grosjean: The discovery of a horizon with marine fauna at the Limbourg-Meuse coal mine at Eysden (Belgian Campine).

May 7.—G. Cesàro: The directions of extinction of an ensemble of two parallel crystalline plates, placed, in monochromatic light, between a fixed polariser and a movable analyser. The conditions necessary for the existence of extinction positions. The fictitious spherical triangle from which these relations can de deduced.—Cl. Servais: The geometry of the tetrahedron.—L. Godeaux: Point correspondences between surfaces.—J. Pasteels: Analysis of the physiology of the egg of the pholas (*Barnea candida*).—A. De Waele: The influence of carbon dioxide on the vernal awakening of the snail. There is an optimum temperature (about 18° C.) for ending the snail's winter sleep: for the same temperatures moisture favours the awakening, and moist carbon dioxide has the same effect. Dry carbon dioxide prolongs the hibernation.—F. Dacos: A crucial experiment for the diffusion of electrons.—E. Leloup: The maturation and fecundation of the egg of *Salpa fusiformis*.—M. Cosyns and R. Moens: Note on piezo-electric quartz. Researches on the limits of the accuracy obtainable with a quartz crystal utilised as a frequency standard. The different factors capable of modifying the frequency are studied singly. The method utilised has the advantage of being a zero method, and at present has an accuracy of the order of one in 10,000.—G. van Lerberghe: The characteristic equation of perfect solutions and of regular solutions.

June 1.—Th. De Donder: The invariantive theory of the calculus of variations (5).—Cl. Servais: The geometry of the tetrahedron (2).—Lucien Godeaux: The connected points of cyclic involutions of order three belonging to an algebraic surface.—Marcel Winants: A generalisation of Fredholm's equation.—P. Swings and Fl. Bureau: The integration of the equation of the quasi-Keplerian orbits by the method of successive approximations.—G. van Lerberghe and Mlle. G. Schouls: A characteristic equation for binary gaseous mixtures.

Official Publications Received.

BRITISH.

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June 1929. Pp. 244. (Melbourne.)

City of Belfast: New Museum and Art Gallery. Publication 97: Guide to Casts of Greek and Roman Sculpture. By I. A. Richmond. Pp. 28. (Belfast.) 3*d*.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 2, Session 1928–29. Pp. ix-xv + 67-186 + plates 3-13. (Edinburgh.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1245 (E. 31): Fuel Flowmeters designed to measure Mass Flow. By P. S. Kerr, with Appendices by D. Robinson, R. J. Penn and W. C. Cooper. (I.C.E. 660: I.C.E. 676: I.C.E. 693.) Pp. 21+8 plates. (London: H.M. Stationery Office.) 1*s*. net.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-third Session adopted at the Annual Meeting of Governors held on the 15th October 1929. Pp. 73. (Glasgow.)

John Innes Horticultural Institution. Conference on Polyploidy held at the Institution on January 19th, 1929, to commemorate the Centenary of the birth of the Founder, John Innes. Pp. 48. (London.)

Education and the League of Nations: being the Report of the Joint Committee of Enquiry into the Teaching of the Aims and Achievements of the League of Nations. Pp. 28. (London.)

Report of the Second Quarterly Meeting of the Ross Institute Industrial Anti-Malarial Advisory Committee, held in the Council Chamber of the Rubber Growers' Association, 2 Idol Lane, E.C.3, on Monday, October 14th, at 2.30 P.M. Pp. 8. (London: Ross Institute and Hospital for Tropical Diseases.)

Imperial Cancer Research Fund. Twenty-seventh Annual Report, 1928–1929. Pp. 18. (London.)

Quarterly Journal of the Royal Meteorological Society. Vol. 55, No. 232, October. Pp. 323-418. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Department of Scientific and Industrial Research. Building Science Abstracts, compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 10, October. Abstracts Nos. 1983-2216. Pp. v+351-386. (London: H.M. Stationery Office.) 9*d*. net.

Seventeenth Annual Report of the Director of the Solar Physics Observatory. Pp. 4. (Cambridge.)

Livingstone College. Annual Report and Statement of Accounts for the Year 1928–29. Pp. 24. (London: Leyton, E.10.)

Journal of the Indian Institute of Science. Vol. 12A, Part 13: i. Amylase from *Zea mais*, by Vinayak Narayan Patwardhan; ii. Enzymes from the Seeds of *Caesalpinia bondu ella*, by Vinayak Narayan Patwardhan. Pp. 185-192. (Bangalore.) 8 annas.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin 43: The Bionomics of *Fasciola hepatica* in New South Wales and of the Intermediate Host, *Limnea brazieri* (Smith) By I. Clunies Ross and A. C. McKay. Pp. 62. Pamphlet No. 13: The Mechanical Analysis of Soils. By C. S. Piper and H. G. Poole. Pp. 19. (Melbourne: H. J. Green.)

Report of the 7th Congress of the Far Eastern Association of Tropical Medicine, British India, December 5th, 10th, 24th, 1927. Pp. iii+193. (Kasauli: Central Research Institute.)

The Journal, Hyderabad Geological Survey. Vol. 1, Part 1: i. The Annual Report for 1337 F. of the Geological Survey Department, H.E.H. the Nizam's Government, with Maps and Sections; ii. A History of the Golconda Diamond Mines, compiled from all available Sources with Maps and Appendices, together with a Reprint from the Transactions of the Royal Society of a Paper read in 1677 by the Rt. Hon. the Earl Marshall of England. Pp. v+62. (Lingsuggur: Hyderabad Geological Survey.) 2.8 rupees.

The Ninety-sixth Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 6, Part 3. Pp. xxxi-xl+187-312+14. (Camborne.) 5*s*.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Professional Paper 154-A: Moraines and Shore Lines of the Lake Superior Region. By Frank Leverett. Pp. iv+72+8 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 3, September. R.P. No. 99: Thermoelectric Temperature Scales, by William F. Roeser; R.P. No. 100: Light Fastness of Lithographic Ink Pigments, by William D. Appel and Robert F. Reed; R.P. No. 101: Effect of Oxidizing Conditions on Accelerated Electrolytic Corrosion Tests, by Henry S. Rawdon and W. A. Tucker; R.P. No. 102: Representation of Aberration Diffraction Effects by means of Rotating Sectors, by A. H. Bennett; R.P. No. 103: Hot Aqueous Solutions for the Quenching of Steels, by H. J. French and T. E. Hamill; R.P. No. 104: Preparation of Experimental Saggar Bodies according to Fundamental Properties, by R. A. Heindl and L. E. Mong; R.P. No. 105: A Suppressed-Zero Electrodynamic Voltmeter, by F. K. Harris; R.P. No. 106: Two Isomeric Crystalline Compounds of *d*-mannose with Calcium Chloride, by J. K. Dale; R.P. No. 107: A Study of Purified Wood Fibres as a Paper-making Material, by Royal H. Rasch. Pp. 343-506. (Washington, D.C.: Government Printing Office.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1927. By El Miralai Ahmed Fouad Bey. Translated from the Arabic by Selim Eff. Khoury. Pp. vii+83. (Cairo: Government Publications Office.) 5 P.T.

Bulletin of the American Museum of Natural History. Vol. 58, Art. 1: A Collection of Brachyuran Crustacea from the Bay of Panama and the Fresh Waters of the Canal Zone. By Lee Boone. Pp. 561-583. (New York City.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 22: Secondary Education. By Carl A. Jessen. Pp. 19. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of Agriculture. Technical Bulletin No. 137: The Pandora Moth, a Periodic Pest of Western Pine Forests. By J. E. Patterson. Pp. 20. 5 cents. Technical Bulletin No. 138: Studies on the Fall Army Worm in the Gulf Coast District of Texas. By R. A. Vickery. Pp. 64. 10 cents. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 207: The Angular Intensity Distribution of Continuous X-ray Spectrum. By Y. Sugiura. Pp. 251-290. 65 sen. Nos. 208-213, 208: Über die Alkalicellulose und deren Bedeutung auf die Herstellung der Kunstseide, von Gen-itsu Kita und Ichirō Sakurada; 209: On the Development of Experimental Methods in Photo-Elasticity, by Ziro Tuzi; 210: Photo-Elastic Study of Stress-Distributions in the Side-Framing of Steel Car, by Ziro Tuzi; 211: Mechanical Properties of Snow-Layer, by Masao Kuroda; 212: A New Design of Cathode-Ray Oscillograph and its Applications to Piezo-Electric Measurements, by Shumpei Watanabe; 213: Study on Impact Test by Means of Piezo-Electricity and Cathode-Ray Oscillograph, by Shumpei Watanabe. Pp. 112+14 plates. 2.20 yen. (Tōkyō: Iwanami Shoten.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 65: Formeln zur genäherten Störungsrechnung in Bahnelementen. Von Bengt Strömgren. Angewandt auf die Planeten 633 Zelima, 956 (1921 IW), 979 Ilsewa, 1035 Amata und 1049 (1925 RB), von O. Möller Nielsen und E. Laursen. Pp. 26. (København.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votocek et J. Heyrovský. Année 1, No. 11, Novembre. Pp. 571-626. (Prague: Regia Societas Scientiarum Bohemica.)

University of Illinois Engineering Experiment Station. Bulletin No. 196: An Investigation of the Friability of Different Coals. By Cloyde M. Smith. Pp. 50. 30 cents. Bulletin No. 197: A Study of Fatigue Cracks in Car Axles. Part 2: A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in co-operation with the Utilities Research Commission. By Prof. Herbert F. Moore, Stuart W. Lyon and Norville J. Alleman. Pp. 30. 20 cents (Urbana, Ill.)

CATALOGUES.

South Africa: Books, Prints, Paintings and Manuscripts. (Catalogue 520.) Pp. 32. (London: Francis Edwards, Ltd.)

Respiration Apparatus designed by Dr. E. Simonson. Pp. 8. (Berlin-Friedenau: Askania-Werke A.G.)

Catalogue of First and Early Editions, mainly of 19th and 20th Century Authors. (No. 337.) Pp. 134. (Cambridge: W. Heffer and Sons, Ltd.)

Christmas Catalogue: a Selection of Books suitable for Presentation. Pp. 16. (London: Francis Edwards, Ltd.)

First Editions of English Literature: the Nineteenth Century to the Present Day. (Catalogue No. 522.) Pp. 56. (London: Francis Edwards, Ltd.)

Zeiss Field Glasses. (T. 380£.) Pp. 54. (London: Carl Zeiss (London), Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 13.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Prof. E. S. Salmon, F. R. Petherbridge, M. H. Moore, and others: Discussion on Apple Scab, its Incidence and Control.

BIOCHEMICAL SOCIETY (at St. Bartholomew's Hospital), at 3 P.M.—H. E. Archer and G. A. Harrison: The Effect of Reaction on the Heat Test for Bence-Jones' Proteinuria.—W. H. Hurtley: Notes on the Determination of Iodine in Blood, etc.—K. V. Thimann: The Precipitation of the Basic Amino-acids of Proteins by Phosphotungstic Acid.—M. J. Rowlands and B. Wilkinson: Vitamin Content of Grass Seeds in Relationship to Manures.—A. G. Norman: The Biological Decomposition of Plant Materials.—D. R. P. Murray and C. G. King: The Stereochemical Specificity of Esterases.—H. Chick and M. H. Roscoe: Stability to Heat of Vitamin B_2 (Anti-dermatitis, Anti-pellagra).—F. K. Herbert and M. C. Bourne: The Non-Glucose Reducing Substances of Blood, with Special Reference to Glutathione.—B. W. Town: Isolation of Isoleucine from Gliadin.—H. G. Reeves and E. T. Renborn: Some Properties of Dihydroxyacetone.—J. M. Gulland and R. A. Peters: Observations on the Reducing Substances in Avian Blood.—G. Graham: The Presence of Homogentisic Acid in the Blood of Patients with Alkaptonuria.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—W. Grose: A Form of Coupling for Geared Diesel Engines for Land and Marine Purposes.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Brown: Observations of (Ch. 678) U Persei, 1924–29.—E. A. Kreiken: The Distribution of the Double Stars along the Giant Series.—J. G. Hagen: On the Significance of Baxendell's Nebulosity.—H. G. Tomkins: Three Features of the Lunar Crust, from Photographs taken at Dedham.—Dr. H. Spencer Jones and J. W. Jackson: Stellar Parallaxes Determined Photographically at the Cape Observatory (2nd list).—W. S. Franks: Visual Observations of Dark Nebulæ.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting, at Royal London Ophthalmic Hospital), at 5.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—J. H. Awbery and Dr. Ezer Griffiths: Apparatus for Determining the Specific Heat of a Material in Powder Form.—Dr. W. E. Deming: On the Determination of the Parameters in an Empirical Formula.—N. S. Alexander: The *J*-Phenomenon in X-Rays.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—Capt. B. H. Peter: The Trend of Development in Railway Signalling.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. G. F. Charnock: Bearings for Power Shafting.
TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—A. E. Woodhead: Commercial Application of the New Esterified Cotton Fibres.
INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—W. Hargreaves: Safety Valves.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Stern: Fastness to Light.—C. D. O. Winslade: Some Aspects of Colour Testing.
MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—N. R. Davis and C. R. Burch: Electric Furnaces for Steel Melting.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—E. Wilson and others: Is Sea Experience essential in order to become a Good Marine Engineer?
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at St. Thomas' Café, Swansea), at 7.30.—E. A. Tyler: Further Notes on Pure Chemicals.
JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Ernest W. Moir, Bart.: Some Engineering Difficulties and how they were overcome (Presidential Address).
LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. J. Spurr: The Dyeing and Finishing of Hosiery Fabrics.
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. F. C. Lea: Physical Testing.
INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND, at 8.—Dr. L. H. Lampitt: The Chemist and Commerce (S. M. Gluckstein Memorial Lecture).
EUGENICS SOCIETY (at Linnean Society), at 8.—Prof. S. J. Holmes: General Morbidity.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Miss D. A. E. Garrod: Cave Excavation in the Near East.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (jointly with Manchester Literary and Philosophical Society: Chemical Section) (at Manchester).—C. Hollins: Patent Law in Relation to the Dyestuffs Industry.

SATURDAY, DECEMBER 14.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—Papers open for further discussion: —Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne, R. G. Carruthers; The Distribution and Sequence of the Non-Marine Lamellibranchs in the Coal-Measures of Northumberland and Durham, Dr. W. Hopkins.—To be discussed:—Report of an Investigation of the Underground Conveying and Loading of Coal by Mechanical Means.
BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at Royal Anthropological Institute), at 3.30.—Dr. A. F. Shand: The Trust of Love.—Dr. Kardos: Phenomenal Thing-moments.
PHYSIOLOGICAL SOCIETY (at St. Thomas's Hospital Medical School), at 4.—L. E. Bayliss and A. R. Fee: The Secretion of Urine from Innervated and Denervated Kidneys Perfused with the Heart-Lung Preparation.—J. C. Eccles and Sir C. S. Sherrington: An Improved Bearing for the Torsion Myograph.—Sybil Cooper and J. C. Eccles: The Mechanical Response in the Isometric Twitch.—A. St. G. Huggett: Respiratory Reflexes in the Fœtus.—W. A. Osborne: Intravenous Administration of Oxygen.—L. B. Winter: Lactose Excretion in the Puerperium and the Isolation of Sugars from Urine and Blood.—E. N. Chamberlain: The Effect of Endocrine Extracts on the Cholesterol Content of the Suprarenals.—Prof. R. J. S. McDowall: The Effect of Carbon Dioxide on Certain Reflex Activities.—Prof. J. Mellanby: The Isolation of Prothrombase from Mammalian Blood.—G. F. Marrian and Dr. A. S. Parkes: The Relative Amounts of Œstrin Required to Produce the Different Phenomena of Œstrus.—M. Hill and Dr. A. S. Parkes: Sensitisation of the Pregnant Uterus to the Action of Oxytocin by the Preliminary Injection of Œstrin.—*Demonstrations:*—Prof. H. E. Roaf: Is the So-called Secondary Excitation of the Retina due to Stimulation of the Rods?—E. M. Landis and T. Lewis: A Case of Raynaud's Disease Treated by Cervical Sympathectomy.

MONDAY, DECEMBER 16.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section—Informal Meeting) (at Loughborough College), at 7.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 7.—C. G. E. Dahl: Calculating Machines.
INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—Dr. H. Norinder: Surges and Over-Voltage Phenomena on Transmission Lines due to Lightning and Switching Disturbances.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—M. H. Baillie-Scott and others: Debate on Are Building Bye-laws destructive of Rural Beauty?
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—M. A. Spender: Further Work on the Great Barrier Reefs.
ROYAL SOCIETY OF MEDICINE, at 8.30.—Reception: Commander L. C. Bernacchi: Southern Polar Exploration.

TUESDAY, DECEMBER 17.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
INSTITUTION OF CIVIL ENGINEERS, at 6.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—Manchester and District Branch) (at Milton Hall, Manchester), at 7.—F. G. Rathbone: Economy in Steam Plants.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—H. D. Babcock: A Photographic Study of the Solar Spectrum in the Wave-length Region 10,000 to 11,000 A.U.—Projection of Films: Dr. W. H. Wright: The Rotation of Jupiter.—H. Rosenberger: (*a*) Living Cells of Human and Animal Tissue, etc.; (*b*) Colloids and their Behaviour.—Dr. W. Clark: A Further Demonstration of the Kodacolor Process.
INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—Mr. Clark: Modern Aero-engines.
SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Medical School, Leeds), at 7.15.—Prof. M. J. Stewart and others: Discussion on Asbestosis and Silicosis.
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—J. Wallace: The Super Sports Motor Cycle.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Small: The Properties of an Air-Steam Mixture as a Working Substance.
BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (Annual General Meeting) (at National Institute of Industrial Psychology), at 7.30; (General Meeting), at 8.—Miss I. Lorrain-Smith, Miss Katherine Pollock, Dr. H. M. Vernon, Major W. S. Tucker, and Dr. M. Culpin: Symposium on Noise.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—L. H. Evans: The Stress-strain Diagram.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—J. P. Mills: A Tour in the Chittagong Hill Tracts.

WEDNESDAY, DECEMBER 18.

SOCIETY OF GLASS TECHNOLOGY (at Science Museum, South Kensington), at 2.—J. B. Murgatroyd: The Choice of Annealing Schedule for Commercial Glassware.—L. H. Milligen: The Strength of Glass containing Cracks.—Dr. J. T. Littleton and Dr. F. W. Preston: A Theory of the Strength of Thermally Toughened Glass.
ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark and I. D. Margary: Floral Isophenes and Isakairs.—Sir Gilbert Walker: On the Mechanism of Tornadoes.—E. W. Bliss: A Study of Rainfall in the West Indies.
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. F. Walker: The Geology of the Shiant Isles.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—A. A. Hughes: Early Bell Founding.
GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 6.15.—Mr. Massé: Carols (Lecture).
LIVERPOOL ENGINEERING SOCIETY (at 24 Dale Street, Liverpool), at 6.30.—Capt. R. S. Capon: Aircraft Performance.
INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.
INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Queen's Hotel, Birmingham), at 7.30.—N. Bland: Front Wheel Drive.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—J. F. Colquhoun: Public Street Lighting, etc.
FOLK-LORE SOCIETY (at University College), at 8.—H. W. Howes: Some Functional Aspects of European Folklore.
ROYAL MICROSCOPICAL SOCIETY, at 8.—W. Wall: A Trifoliate Pedicellaria in *Echinus miliaris*.—F. V. Welch: A Microscope Lamp.—J. E. Barnard: Note on Dark Ground Illumination.

THURSDAY, DECEMBER 19.

LINNEAN SOCIETY OF LONDON, at 5.
ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by Means of Thermal Storage.—T. G. N. Haldane: The Heat Pump—An Economical Method of Producing Low-Grade Heat from Electricity.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Informal Meeting), at 7.—L. Eveleigh: The Zöechrome Process of Natural Colour Kinematography.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.—G. Shearing and Capt. J. W. S. Dorling: Naval Wireless Telegraphy Communications.
CHEMICAL SOCIETY, at 8.—Prof. A. Smithells, H. Whitaker, and Miss T. Holmes: The Influence of Hydrogen and of Water Vapour on the Ignition of Carbon Monoxide.—F. H. Burstall and Dr. S. Sugden: The Parachor and Chemical Constitution. Part XIV. Tellurium Compounds.—K. A. N. Rao: Studies in 'Strainless' Rings. Part II. The Effect of Transdecalin on the Carbon Tetrahedral Angle.—J. N. Ashley and C. R. Harington: Synthesis of 1-2-thiol-histidine.—Prof. F. L. Pyman: 2-Thiol-4(5)-β-aminoethyl Glyoxaline (2-thiolhistamine).
INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Manchester).—Papers on Reclaimed Rubber.

FRIDAY, DECEMBER 20.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Determination and Isolation of the Picture.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Challis: Line Signalling on the Southern Railway.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. E. Cammaerts: Italian and Flemish Art: A Contrast.

PUBLIC LECTURES.

SATURDAY, DECEMBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Witchcraft.

MONDAY, DECEMBER 16.

UNIVERSITY OF LEEDS, at 5.15.—J. Gray: Ciliary Movement.

TUESDAY, DECEMBER 17.

CARDIFF TECHNICAL COLLEGE, at 7.30.—W. S. Vernon: X-Rays.

WEDNESDAY, DECEMBER 18.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. L. Collis: Industry in Relation to Personal and Public Health.

NATURE

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The National Museums and Education.[1]

TO-DAY, as at no past period in the history of the museums of Great Britain, active and enlightened minds are applying themselves to review the accomplishments of these institutions and to devise means for their greater participation in the life of the nation. In endeavouring to interpret the 'new museum outlook' which loomed through this outburst of interest, we alluded in a leading article in NATURE (June 29, 1928) to a museum feeling in the air. Fresh and welcome evidence of this spirit is afforded by Part 1 of the Final Report of the Royal Commission on National Museums and Galleries, to which references have already been made in our columns.

The whole field of museum activity in Great Britain has now been covered. The Carnegie United Kingdom Trustees, through Sir Henry Miers, surveyed the land of the provincial museums, and they found a desert, brightened, it is true, by occasional oases, but nevertheless an arid country which could be made fruitful only by an infinitely patient and plenteous irrigation, some of the streams whereof must be of pure gold. The Royal Commission, facing another quarter, has looked upon the great institutions where are housed the nation's treasures, and although barrenness is here replaced by a certain amount of jungle growth—for the golden streams have been running steadily if not copiously for many years—yet here also is envisaged in the near distance a land of promise towards which the museums must strive.

This section of the Final Report embodies the general conclusions and recommendations of the Commissioners; a second section to be issued at an early date will contain the findings relating to individual institutions. While the latter, therefore, will fix the milestones along the highway of museum progress, to the former we look for the finger-posts pointing the general direction of advance and indicating the objective of the museum body as a whole. Three big problems are involved in any forward movement—the inter-relationship between the national museums and galleries themselves, the relationship of the national institutions to similar provincial bodies, and the share to be taken by the national institutions in education. This last lies at the very heart of the matter, and its proper solution can be the only means of

[1] Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20 September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office, 1929.) 2s. net.

enabling the museums to play their due part in the life of the nation.

That lack of vision of the educational possibilities of museums and galleries which appears to be characteristic of British administration is painfully evident in the terms of reference set for the guidance of the Commission. Education is mentioned there only once, and with a negative emphasis which does not make for encouragement —"to consider in what way, if any, expenditure may be limited without crippling the educational and general usefulness of the Institutions"—and not in all the eight instructions is there a word to suggest that in the possibility of creating new contacts with childhood, youth, and manhood, might be a field worthy of the closest inquiry.

The Commission, however, has been bolder than its mandate, and appreciating that "the National Museums and Galleries are *essentially educational institutions*", makes many suggestions the adoption of which would add to the teaching efficiency of the institutions. It cannot be said, however, that the attainment even of these suggestions will bring the educational facilities of British museums within measurable distance of those already in full force in the museums of the United States of America, to which we have made favourable reference again and again in the pages of NATURE. To take one example: the report, in recording certain outstanding deficiencies in the national museum service of Great Britain, suggests the creation of a museum of ethnography, a museum of casts, a folk museum, and an Oriental museum, but there is no hint of a prospective children's museum, such as that which has been so successfully developed at Brooklyn, New York. Yet it is obviously unfair to expect children, though they do their best, to grapple with exhibits arranged and labelled for adults.

Part of the present-day deficiency in the educational organisation of museums and the like is undoubtedly due to that lack of vision which is apparent in the terms of reference. Whilst the stock educational bodies have advanced relatively by leaps and bounds, the museums stand still. The report reveals the insufficiency with unanswerable statistics:

"For the last twenty-five years, the development of the National Institutions measured in terms of State support has advanced hardly at all as compared with the development of elementary education, secondary education, or university education. The exchequer expenditure in respect of these three forms of education in England and Wales has in this period increased approximately as follows: elementary education threefold: secondary education and technical education eightfold: university education nineteenfold. In the case of National Museums and galleries expenditure has increased twofold: in other words, taking account of the change in the value of money, it has almost stood still. . . . It seems to us that so great a disparity is an indication not only of a lack of appreciation of the purpose of these Institutions, but of a definite defect in the relations between them on the one side and governmental authority on the other."

To three main lines of development the Commissioners look for increased efficacy in the spread of knowledge: the enlargement in scope and improvement in quality of circulating collections, the more effective display of exhibits, and improved methods of contact with the public. We cannot follow here the recommendations in detail, but we note that while the further development of the loan system of the Victoria and Albert Circulation Collection to schools of art, secondary schools, and training colleges is contemplated, no suggestion is made of participation in these great privileges by elementary schools, although the success of the system organised by the great American museums rests on this lowly basis. Nor is it quite clear that natural history material is to be included in the enlarged Victoria and Albert central circulating agency, though experience elsewhere has shown that the circulation of life-histories and natural groups of common creatures and plants is perhaps the best appreciated of all the activities of museums in relation to school work, and although the Commission views with favour the ultimate circulation of natural history and other scientific objects.

It need scarcely be said that much could be done in existing space to improve the appeal and the teaching quality of exhibits. We are reminded of the comment of a young German friend, familiar with the Deutsches Museum in Munich and the other great German institutions, who after a visit to London a month ago, remarked that one of the leading museums there was more like an antique shop than a museum.

A great future lies in the tightening up of contact with the people. Better publicity, publications with a popular appeal, the development of the guide-lecturer system, lecture theatres and evening lectures, are some of the most obvious methods. The report passes lightly over the question of the inadequacy of the present staffs of the national institutions to carry out the many reforms that are foreshadowed and are indeed long overdue. It suggests the appointment in the larger institu-

tions of a whole-time officer whose duty it would be to keep contact between the public and officials. We doubt if this step, progressive though it is, would meet the case, and we look further to a closer *rapprochement* between education authorities and museums, and the consequent delegation of teachers wholly set aside for the conduct of school classes in museums, for the foundation of that close contact which alone can bring the nation's treasure-houses of art and science adequately into the educational life of the day.

Aviation and the Future.

The World, the Air and the Future. By Comdr. Sir Charles Dennistoun Burney. Pp. xxiv + 356 + 24 plates. (London: Alfred A. Knopf, 1929.) 21*s*.

THE vast significance of air transport to civilisation in general and to the British Empire in particular has as yet been appreciated by comparatively few. That Britain, which of all nations is the one most called upon to lead the way in the use of this wonderful instrument for linking the world together in peace and prosperity, should have fallen so far behind others, in particular the United States and Germany, in civil aviation developments as to be no better than third-rate, is little short of a tragedy.

Those who have realised this regrettable state of affairs have impatiently awaited a book that would enable the thinking man to appreciate the deep significance of air transportation for us in the progress of mankind. It is to Commander Sir Dennis Burney that we are indebted for the first real attempt to write such a book. The subject is big and contains many difficult problems, but, although some of his arguments and assertions may be subject to criticism, the main principles, propounded with marked sincerity and courage, may be expected to survive.

To all men, especially to men of science and men of commerce, it is increased *speed of communication*, whether by personal contact or by written document, that is daily in greater demand. It makes co-operation more effective and increases efficiency by enabling more work to be done in a given period of time, quicker contact to be established with minds in distant lands, and a better use to be made of leisure time. Air transportation, whether we like it or not, has arrived to impart this acceleration to our lives.

At present, aviation is in its infancy and its teething troubles must be recognised as such. It is as ridiculous to point to the present limitations of aircraft and their operations and to the relatively high cost of air travel as an argument that they cannot be of any commercial use, as to say that a child which cannot work efficiently and pay its own way will never do so. There is a tendency to ignore the fact that there already exist air services which, due to special conditions, pay their way handsomely, and each day progress is made towards the establishment of economically run services where conditions are not so favourable.

The construction and mechanism of aircraft require the attainment of the highest perfection, and therefore their successful economic development will depend to an exceptional extent on the application of the results of the research work at present occupying the attention of several branches of science. It thus appears probable that the attainment, not perhaps of vastly higher speeds, but at least of the greater efficiency we require, is likely to be a very rapid process.

Just as the coming of the steamship, the railway, and the motor-car completely changed the life of each nation into which they intruded, so will aircraft entirely change the character and mode of life of the world. Whereas in the past the units influenced have been separate nations, in the future there will be but one unit—the world. Aircraft, in other words, will, by the nature of the operations, render all obstacles to free movement about the world at a speed of 100 m.p.h. or more, so objectionable, that the force of international public opinion will sweep aside all national barriers and other man-made obstructions. Aircraft "are going to create the conditions of their own development. Indirectly, and without altogether realising it, they will dictate policies, transform issues, solve old problems in a new way, and bring important new changes into the psychological structure of human society."

Can we possibly doubt the far-reaching effect this will have on the human race? On the contrary, it is clear that we are indeed witnessing the beginning of a new phase in our evolution. It is perhaps prophetic that at a time when the world is struggling to free itself from the tangles of numerous man-made restrictions which prevent humanity moving on to a higher plane, this mode of locomotion in that free, universal medium, the air, should have appeared to aid it. Flight implies something more than an extra rapid means of transport; it implies a new framework in the mind, a new mental outlook affecting all our thoughts and activities.

No one who reads this book by Sir Dennis Burney can fail to recognise this new outlook. The mental shock experienced by the realisation of the great changes that are impending will be stimulating or unpleasant according to the temperament of the percipient. It may be said that the change from surface transport to air travel is as big a leap, when considered in its psychological effect on the ordinary man, as that which the mathematician faced in the acceptance of Einstein's theory of relativity. In each case a dimension has been forced on the attention of unwilling recipients in a manner extremely disturbing to complacent minds.

The remarkable thing about aviation is that it contains such vast potentialities for the solution of each of four of the most vital problems we have to face to-day, namely :

(1) *Commercial Efficiency.*—The saving of time over long distances enables a business man, his correspondence, his samples, his contracts, and his money to act more quickly and go farther afield. Air transport will therefore be of prime importance to commercial prosperity.

(2) *Empire Development.*—The ability of aircraft to cover ground quickly enables even difficult countries to be easily and quickly surveyed and exploited, enables large areas to be efficiently inspected and controlled at low cost, and keeps the pioneer workers at the outposts of the Empire within easy reach of civilisation.

(3) *Imperial Solidarity and Security.* — The essential for all work of Imperial co-operation, both in peace and war, is rapid and efficient co-ordination and intercommunication. Air transport, by minimising large distances (in terms of travelling time), will draw the Empire together and thereby secure a better understanding and increased co-operation. Moreover, effective Imperial defence at present depends primarily on the security of England, and that is essentially an air matter and requires an air-active nation to support it.

(4) *International Peace.*—The ultimate establishment of a peace psychology throughout the world rests on the attainment of a better understanding between the peoples of the different nations and on the recognition of mutual cultural values. Only by a greatly increased intermixing and intercommunication of the peoples can this be brought about. Air transport, by its international nature, and by its impatience of all obstacles that prevent rapid travel, will assuredly achieve this in the end.

Sir Dennis Burney has a great deal to say about all these subjects in the first four chapters of his book. The problems of Imperial defence are dealt with at great length, and he shows that, although in the main they are naval problems, the defence of Great Britain is an air problem. Not only, therefore, is a complete re-orientation of naval policy required, but also a reserve of civil pilots and of aircraft manufacturing power as an essential support for our small air force. Such an economic reserve can only be built up by the expansion of civil aviation both at home and in the Empire.

Sir Dennis makes no demands for increased armaments ; on the contrary, the chapter on international peace is a strong plea for an organised move towards peace and for the exploitation of this inherent ability of air transportation to bring nations together. In the end, aviation must be made international, and will thus help to ensure the peace of the world.

The second half of the book is devoted to a discussion of the technical capacities of different kinds of aircraft and their probable future development. In Sir Dennis's view, the airship will be the vessel for trans-oceanic flights, while the flying boat already shows great promise for long-distance coastal routes and is capable of development to a far greater size than the aeroplane.

The chapter on airships, which received undue prominence in the daily Press, will naturally be of interest to all readers. It was never claimed that *R100* and *R101* would be anything but experimental, and already it appears that the expenditure on this experiment, in view of its Imperial importance, has been justified by the knowledge gained. Sir Dennis Burney admits that he has changed his mind regarding certain aspects of the airship problem, that he underrated the difficulty of handling and mooring such large ships, and that for commercial operation a higher cruising speed, namely, 90 m.p.h., is essential. He offers, however, ingenious solutions for the problems : first, a mechanically operated mooring and docking raft ; and secondly, the use of fuel-gas engines more efficiently disposed on the ship. He also advances a completely new solution in his proposed elliptical airship, which he claims would be capable of landing on any sheltered waters and of mooring like a marine vessel.

The book concludes with a chapter of constructive proposals for the international organisation of flying and for Empire air development. A revision is suggested of the Imperial defence policy which will save such a sum that £10,000,000 could easily be set aside annually and devoted to the adequate expansion of civil aviation.

The reader may ask, What is the standing of Great Britain and the Empire in the air developments of to-day? The answer is that while our men of science and our craftsmen have left us technically unsurpassed, we occupy an altogether inferior position in the air commerce of the world. We have lost aircraft markets we might have obtained, and the development of our Imperial and international air routes, though sound, has been so hopelessly slow that in the amount of scheduled commercial flying we stand to-day no better than a bad fourth on the list; the United States, Germany, France, and possibly Russia, are more active than we. These nations pay large subsidies, either directly or by mail contracts, in order to develop and secure in advance a stake in the great future that is coming to aviation. Great Britain, the transport nation of the world, spends a negligible amount on this new form of transport, and is thus failing to secure her share of what is destined to be more vital to her than to any nation in the world.

There is great work to be done in rousing the nation to a realisation of the great world-wide opportunity it is neglecting, and of the fact that the future security, prosperity, and prestige of the Empire is being jeopardised by our apathy. It is a hopeful fact that there is a body at work to bring this knowledge to the people, namely, the Air League of the British Empire (Astor House, Aldwych, London, W.C.2).

Sir Dennis Burney is to be congratulated on completing so successfully a pioneer book, a book of vision, on matters of such vital significance to us all. It cannot fail to interest everyone who wishes to see the British Empire retain a leading part in the progress of human evolution. G. MERTON.

Persuasion and Belief.

Phantom Walls. By Sir Oliver Lodge. Pp. 251. (London: Hodder and Stoughton, Ltd., 1929.) 5*s.* net.

THIS volume is a sketch of Sir Oliver Lodge's well-known theories concerning the universe, man, survival, and immortality. There would not appear to be anything new in his treatment of these matters in the present work; rather is it intended for a different type of audience. For on examination, it seems that the book is primarily put forward as a persuasive essay to be read by those who, for whatever cause, are forsaking organised religions and embarking independently in their quest for truth. As a handbook of spiritualism for the bereaved person or for the perplexed cleric the book is admirable; as an exposition of the same theme for the unemotional and critical man of science, it is not altogether convincing.

Sir Oliver sets out by remarking upon the gradual secession of educated people from the churches, but "the instinct for worship" which he believes man to possess prevents him from becoming altogether divorced from spiritual realities. Hence, if through spiritualistic manifestations it can be shown that man survives bodily death, then the instinct for worship can be given full play, fortified by the assurance that the saints and great men of the past still live and still struggle for the elevation of the race, although, like ourselves, subject to a Higher Power which "guides humanity in some far seen and hopeful direction".

Now Sir Oliver has received, it seems, indubitable proof of the persistent continuity of individual personal existence. Therefore it behoves him to explain to those who have not been granted this knowledge how the fact of survival can be reconciled with physics and psychology, with biology and evolution. The first thing to understand is that the brain is merely the organ of the mind. Thought is no more in the brain than music is in the violin. The mind cannot be damaged by a brick-bat: only the instrument through which it manifests can thus be destroyed.

This hypothesis opens up the attractive idea that minds can manifest themselves when they possess the appropriate instruments. On earth they make use of material brains, and then only for a short time; but, according to Sir Oliver, the earth life is an exceptional thing. We are spirits temporarily incarcerated in matter and we are more at home in the spirit world than we are here (p. 100). Moreover, even imprisoned as we are in matter, the reality of the spirit world is often borne in upon us. Such phenomena as veridical dreams, 'direct' voices, premonitions, and trance lucidity are indications of its existence, and the so-called cross correspondences are full of almost incontrovertible evidence. Personality survives bodily death: the mind functions by means of another instrument after the brain has long crumbled to dust. This theory of *personal* survival relieves us of having to accept the idea that all living things survive and permits us at the same time to grant survival to domesticated pets and other creatures which exhibit signs of conscious striving for unrealised ends (p. 75). Indeed, the chance of survival appears to depend upon the growth of the neopallium through which those elements may function which are worthy of a continued existence.

It is true that Sir Oliver sees a few of the difficulties in the way of accepting his theories of man's destiny. But the new outlook in physics is in no wise antagonistic. Science, it seems, is becoming idealistic and bio-physics is beginning to investigate the interaction of life and matter. Indeed, simple ideas are tending to clarify what were at one time momentous problems. Such questions as those concerning prayer and miracles can best be understood by an argument from the lower animals. To the cat which wants the door opened, the man who obliges is a higher being ; and we are able to perform similar services to bees and birds when trapped in closed rooms. Difficulties vanish when one thinks of them as the lower and ourselves as the higher beings.

The spiritistic hypothesis solves many of the difficulties of man's life and ultimate destiny. Undoubtedly, as Sir Oliver points out, it is somewhat hard to formulate in a precise and scientific manner. It is, he says, "an appeal to the activity of unknown agents, acting by unknown methods, under conditions of which we have no experience, and by means of which we are unaware" (p. 209). Indeed, it does not sound very hopeful—or helpful.

A Bibliography of Applied Science.

Mededeelingen van het Nederlandsch Instituut voor Documentatie en Registratuur. No. 6, 1928, 10/12. Pp. 2073-2249. (Amsterdam: Nederlandsch Instituut voor Efficiency, 1929.) Bimonthly, £2 10*s*. a year.

THIS unassuming but extremely valuable publication is the descendant of the "Index of the Technical Press" which was commenced in 1903 by the International Institute of Bibliography at Brussels to supply the need for a comprehensive bibliography of applied science. The "International Catalogue of Scientific Literature" had recently been started on the domain of pure science, and the "Index of the Technical Press" was intended to cover the ground on the applied side. Afterwards the title was changed to "Revue de l'Ingénieur et Index technique". The present publication was commenced in 1922 by the Dutch Institute of Documentation under the auspices of the Institute.

The series from 1903 to the present date is the only comprehensive bibliography devoted to the various aspects of the application of science to industry, and is undoubtedly of the greatest value as an index to the literature of applied science. The current volumes contain some sixteen thousand entries a year and relate to such subjects as hygiene, testing materials, steam engineering, electrotechnics, electric generation and transmisson, telegraphy, radio communication, mechanical engineering, civil engineering, railways, hydraulic engineering, transport, aviation, agriculture, industrial organisation, chemical technology, fuels, gas and oil technology, mining, heating and lighting, ceramic industries, dye manufacture, paints and varnishes, metallurgy, paper making, textile industries, rubber industries, building construction, photography, etc.

The entries are printed in type script in two columns on one side of pages of quarto size and classified by the Universal Decimal Classification of the International Institute of Bibliography, which is now rapidly coming into use as standard international classification. In addition to the classification numbers, which are printed at the beginning of each entry, the names of the main classes are printed at the heads of the pages, so that, by looking through the headings, a clue to the entries on a particular topic may be obtained without consulting the tables of the classification. As a further convenience, a dotted line is printed at the end of the entries in each class. This makes it unnecessary to read the classification number at the head of each reference, when once the appropriate division has been found. It is intended that the bibliography should be cut up, mounted on cards, and filed in arithmetical order of the classification numbers, so as to form a cumulative bibliography, in which all the references relating to a single subject fall together automatically as received. As, however, the pages are issued in loose leaf form, it is possible to file them, as received, in a single series under the classification number of the first entry on each page. This will serve to bring the entries on each subject fairly closely together.

The bibliography is really indispensable to scientific investigators, research associations, and all who need a ready means of gaining access to the literature of a technical subject. It is particularly useful to those who adopt the Decimal Classification for their own subject-matter indexes, as the mounted references fall naturally into place with all references classified on the same system, and in this way a very comprehensive bibliography of a special subject can be built up.

It is unfortunate that the printing is poor. This is due to lack of support in the past. But, as the bibliography attains a larger circulation, it will be possible to improve the style. S. C. BRADFORD.

Our Bookshelf.

(1) *Die Arithmetik in strenger Begründung.* Von Prof. Otto Hölder. Zweite Auflage. Pp. v+73. (Berlin: Julius Springer, 1929.) 3·60 gold marks.

(2) *Theory and Application of Infinite Series.* By Prof. Dr. Konrad Knopp. Translated from the second German edition by Miss R. C. Young. Pp. xii+571. (London and Glasgow: Blackie and Son, Ltd., 1928.) 30*s*. net.

(1) THIS little book gives a method of basing the theory of arithmetic on the properties of finite aggregates and on Dedekind's section. Prof. Hölder holds the view that an arithmetic founded solely on postulates and axioms must be insufficient, since even in this case series of operations must be counted.

(2) Prof. Knopp's book is beautifully printed and arranged. Of the three parts into which it is divided, the first begins with the theory of real numbers, the starting-point being an assumption of a knowledge of Hölder's arithmetic of rational numbers. From this point, Dedekind's theory of irrational numbers and the notion of convergent sequences are introduced. The second part discusses the foundations of the theory of infinite series, and the third part proceeds to modern developments. Here the author gives many valuable chapters, including an illuminating discussion of Fourier series. Chapter xiii. contains a very useful digest of methods for associating the notion of 'sum' with divergent series. Chapter xiv. on Euler's summation formula and asymptotic expansions has been specially written for the English edition. The author's aim has been especially to help the private student, and to this end many explanations of difficult points and apt illustrations have been included. The translation has been well done and there is an easy flow of the language.

In both the above books Dedekind's theory of irrational numbers has been adopted, presumably because of the uniqueness of their representation. But Cantor's theory lends itself more naturally to a simple detailed treatment, and, being fundamentally equivalent to Dedekind's theory, might with advantage have been used. L. M. M.-T.

Geologie von Perú. Von G. Steinmann. Mit Beiträgen von R. Stappenbeck: *Nutzstoffe*; F. Sieberg: *Erdbeben*; C. Lissón: *Geologische Karte.* Pp. xii+448+9 tafeln. (Heidelberg: Carl Winters Universitätsbuchhandlung, 1929.) 28 marks.

THIS work by the veteran Prof. G. Steinmann gives an excellent summary of what is at present known of the geology of Peru. Unlike Bolivia, Chile, Colombia, and Venezuela, which were visited in the first half of the nineteenth century by D'Orbigny, Darwin, and Humboldt respectively, scarcely any investigations into the geology of Peru were made before the work of Raimondi, whose first publication appeared in 1862. The bibliography now given by Steinmann extends to 22 pages, but owing to the extent of the country and its climatic and physical characters, vast tracts are still unknown or almost unknown geologically. Much of the knowledge we have is due directly or indirectly to the work of geologists who have been primarily concerned with the investigation of the mineral resources (gold, silver, zinc, copper, quicksilver, iron, nickel, cobalt, wolfram, antimony, petroleum, coal, etc.).

The account of the stratigraphy, tectonics, and geological history occupies nearly three-quarters of the book, and is followed by a section on the mineral resources by R. Stappenbeck, and an account of the earthquakes of Peru by A. Sieberg. The geological record begins with the Archæan crystalline rocks, followed by the pre-Cambrian phyllites, the Middle and Upper Ordovician, the Lower Devonian, the Upper Carboniferous and Permian, the Trias, Jurassic, Cretaceous, Eocene, Miocene, Quaternary. The chief breaks in the succession are (1) between the Archæan and the phyllites, (2) during the whole of the Cambrian and probably Lower Ordovician, (3) during the Middle and Upper Devonian and Lower Carboniferous, and (4) between the Chalk and the Middle Eocene. The work is illustrated with numerous sections, and with reproductions of published figures of characteristic fossils. The map of the Cordillera, showing the distribution of the formations so far as known, has been prepared by Steinmann and Lissón.

A Treatise on Pharmaceutical Chemistry: embracing certain Special Topics of Analytical, Organic and Physical Chemistry as they are related to Pharmacy. By Dr. John C. Krantz, Jr. Pp. 282. (London: Henry Kimpton, 1928.) 15*s*. net.

IN this volume the author has selected certain subjects for special consideration. The work is divided into three parts: in the first, the quantitative estimation of certain inorganic elements, of pharmaceutical importance, either as remedies or impurities, is discussed; the actual methods are not always given in detail, but reference is made to the U.S. Pharmacopœia. The method and its theoretical implications are then submitted to discussion. The section is intended to serve as an illustration of the importance of quantitative methods for pharmacists. The second part is devoted to a consideration of the structure and methods of preparation of a number of complex organic compounds used in medicine, such as the hypnotics, local anæsthetics, antipyretics and bactericides, including the organic arsenicals. This section is useful for quick reference to the formulæ of a number of substances which are in everyday use. In the third part, there is a theoretical consideration, accompanied by illustrative experiments, of certain aspects of physical chemistry.

On the whole, this can be considered an advanced text-book, probably of greater value to the pharmaceutical research worker than to the student. For readers in Great Britain it suffers from the disadvantage that the possession of the U.S. Pharmacopœia is an essential prelude to its use. On the

other hand, the second and third sections should be of value to chemists and pharmacologists as well as to pharmacists.

Paleontology. By Prof. Edward Wilber Berry. Pp. xii + 392. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 17*s.* 6*d.* net.

THE author, in his preface, describes the scope and intention of this book, which is to lay emphasis on one hand on the evolutionary story that the study of palæontology tells us, and on the other to illustrate the adaptation of animals to their environment. The author further states that his purpose is "to interest rather than to repel the beginner—a pedagogical principle all too frequently ignored". In these aims he appears largely to succeed, and the book compares well with others of its class. Naturally, in a book which deals with the whole of palæontology from Protozoa to man in 364 pages, there must be either compression or omission, and the second alternative has wisely been chosen, with the result that the reader, who is supposed to be a beginner, is at all events saved from mental indigestion.

Of the figures and diagrams, a good proportion, especially in the chapters on invertebrates, are the author's own, are refreshingly new, and remind the reader that extinct animals were once alive. In the various tables of affinity and descent a cautious position is held. Here and there a captious critic will find that the author has not always been able to keep up with the flood of recent discovery, but from some slips and errors no writer of a text-book can hope to be free, and there is none that prevents the book from being recommended to a student as a jumping-off ground to larger and more detailed works.

Trailing the Giant Panda. By Theodore Roosevelt and Kermit Roosevelt. Pp. xi + 278 + 33 plates. (New York and London: Charles Scribner's Sons, 1929.) 16*s.* net.

THE giant panda (*Æluropus melanoleucus*) is rather like a bear, with black spectacles, saddle, forearm, and quarters of dark brown, and the rest of the body white. He lives in steep bamboo jungle, on which he feeds, sleeps in a hollow tree, and ranks as a sahib because he does not cry when shot. No civilised man had ever seen him alive until the present authors tracked down an old male, with fatal results for the panda. Scarcely better known is the takin (*Budocras taxicolor*), half goat, half antelope. Very rare is the golden monkey. These and other rare species were the quest in a successful expedition, by the Bhamo route from Burma into the Chinese provinces of Yünnan and Szechuan, penetrating a wild region to northward of the Yangtze-kiang and leaving by way of Indo-China, a journey of about two thousand miles.

Among the numerous and excellent photographs is one of Mt. Koonka, mapped here by some optimist as thirty thousand feet high, pending more careful survey. The country as a whole, however, is unsurveyed, large parts of it unexplored by Europeans, although inhabited to the last possible limits of saturation, partly by Chinese, but mainly by semi-independent tribes, not always cordial to visitors. The present work deals mainly with the adventure, but contains a great deal of interesting material, while the scientific staff, collecting for the Field Museum at Chicago, will doubtless publish their results through the usual channels.

The Biochemistry of the Amino Acids. By Prof. H. H. Mitchell and T. S. Hamilton. (American Chemical Society Monograph Series, No. 48.) Pp. 619. (New York: The Chemical Catalog Co., Inc., 1929.) 9.50 dollars.

IN this monograph the authors have given a detailed account of the chemistry and physiology of the amino-acids, their preparation, determination and properties, and the part they play in metabolism and nutrition. They have examined the available evidence very critically, more especially in the physiological chapters, so that the work forms a very useful review of our present knowledge. The fact that the monograph is of the size of many text-books of physiology indicates the extent of the literature dealt with. The chemical chapters account for about one-third of the volume: the remaining two-thirds give an up-to-date account of the digestion of the proteins and the absorption of their constituent amino-acids, the catabolism of these compounds and their relationships with carbohydrate and fat metabolism, the breakdown of the individual amino-acids being considered in detail. Finally, there are chapters on their specific dynamic action, on the catabolism of tissue protein, and on the nutritive values of proteins and the protein values of foods in nutrition. The book will be of great use as a work of reference by research workers, and also to all advanced students of biochemistry and physiology.

A Challenge to Neurasthenia. By Doris Mary Armitage. Pp. 52. (London: Williams and Norgate, Ltd., 1929.) 5*s.* net.

THIS book is principally an appreciation of the late Dr. L. S. Barnes. It describes his attitude to neurasthenia and his method of treating the neurasthenic, which appears to have been by the application of his own strong personality in encouragement, coupled with an appeal to the patient's intelligence. Apart from the statement that Dr. Barnes considered all neurasthenic troubles to originate in fear, there is no indication of what he considered to be the etiology of functional nervous disorders. This defect, and a lack of detail regarding the line of treatment, will hamper other physicians attempting to follow the same method of psycho-therapy. The book does, however, encourage doctors to pay serious attention to the neurasthenic, and provided the tendency to regard the subconscious mind as a sort of separate personality is not taken too literally, it will also encourage patients to believe that neuroses are susceptible to treatment. It is a matter for regret that Dr. Barnes did not live to publish his own views on psycho-pathology and psycho-therapy.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Earthquake South of Newfoundland and Submarine Canyons.

THE powerful earthquake south of Newfoundland which, on Nov. 18 and 19, broke eleven submarine cables in at least twenty-three places and devastated the southern coast of Newfoundland, promises important evidence as to the nature of the submarine canyons off the Atlantic coast of Canada and the United States. The earthquake was obviously of the highest order of intensity at its centre, for it overthrew chimneys, and was therefore of the order of over No. 7 on the Rossi-Forel scale in the towns of Nova Scotia, more than 400 miles from its origin, and it occasioned a tsunami or earthquake wave, which drowned 26 people on the Burin Peninsula in Newfoundland, did extensive damage to property, and in places swept inland to the height of 100 feet.

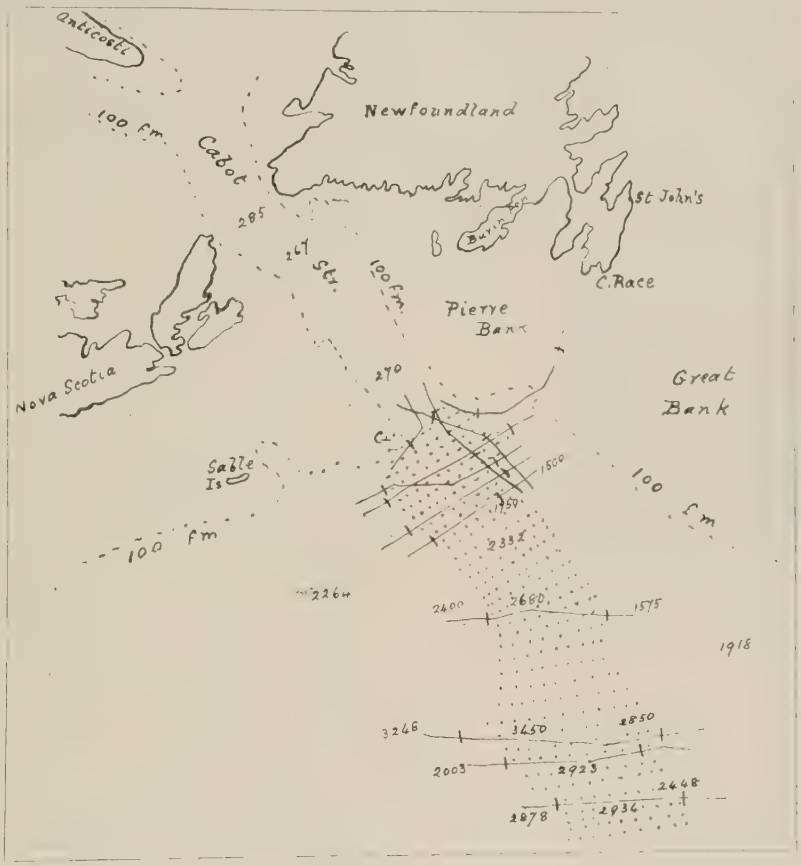

FIG. 1.—Sketch map of the Cabot Strait earthquake, Nov. 18–19, 1929.

The thin lines represent the twelve broken cables: the cross bars the approximate positions of twenty-three fractures.
The dotted area represents the probable foundered band in continuation of the Cabot Strait.
⊥ Approximate position of the *Caledonia* when violently shaken by the earthquake.
The devastation on the coast of Newfoundland was mainly near the Burin Peninsula.
Depths in fathoms.

The accompanying sketch map (Fig. 1), based on one kindly supplied by Mr. L. Robinson of the Western Union Telegraph Co., and on a list of seven breaks on the cables of the Commercial Cable Co., by Mr. R. J. Hughes, shows that the breaks are mainly in two roughly parallel lines in continuation of the trough-like valley, in places 285 fathoms deep, through Cabot Strait. The lines are not fully straight: but as the positions of the fractures are based on tests from the shore-ends, they may not be exact, as they may be displaced by strains or injuries to the cable outside the main fractures.

Eleven of the twelve damaged cables have two fractures apiece, at the distance of usually from 80 miles to 150 miles apart. The positions are roughly in two lines, which continue the straight steep side of the trough of Cabot Strait. That trough is up to 285 fathoms deep and trends from north-west to south-east. The earthquake appears to have been due to a renewed subsidence on the submarine southern continuation of Cabot Strait, though the trend bends to south-south-east. The depths along the middle of this sunken bend were 1750, 2332, 2680, 3450, and 2934 fathoms, and the depth is usually hundreds of fathoms greater than in the area on either side. The earthquake is probably due to a fresh subsidence of the floor of this submarine rift valley.

The new evidence throws light on the nature of the famous submarine canyon of the Hudson River off New York, which makes a notch in the 100 fathom line by a depression 2400 feet deep. The buried channel inland is known to be in places bounded by faults.

The St. Lawrence Valley has been interpreted as a strip sunk between parallel faults by Mgr. Laflamme (*Trans. R. Soc. Canada*, ser. 3, vol. 1, 1908). Its tributary, the Saguenay fiord, the site of the powerful earthquake of February 1925, the latest of the violent shocks of the Charleston—New England—St. Lawrence series, is probably due to subsidence as its bed is in places 140 fathoms below sea-level. It trends approximately east and west in line with the pivotal line across Newfoundland.

Such submarine canyons have been attributed to four processes: to excavation by rivers when the land stood thousands of feet higher than at present; to the power of glaciers to excavate troughs deep below sea-level; to the accumulation of sheets of sediment on either side of a channel kept clear by currents, as suggested by Darwin for the canyons of the Blue Mountains in New South Wales, and by J. Y. Buchanan for the submarine canyon off the Congo. The fourth explanation is that they, like fiords, are due to the subsidence of strips of land along faults; that conclusion, advanced in "The Nature and Origin of Fiords" (1913) appears strongly supported by the evidence of this new earthquake, which in this case has not enjoyed

the comparative harmlessness of submarine disturbances as it lies across the main series of trans-Atlantic cables.

The re-sounding of the ocean around the epicentral area of the Cabot Channel earthquake may be expected to reveal instructive changes in depth.

J. W. GREGORY.

4 Park Quadrant, Glasgow, C.3.

Method of Determining the Position of the Symmetry Axis of a Crystal by means of X-Rays.

A NARROW beam of X-rays, passing through the same point of a thin plate of a crystal, and moving in such a way that it successively occupies all the possible positions within a definite solid angle, will have Bragg's reflections from the atomic planes in the crystal. Their traces on a photographic plate, which is fixed relatively to the crystal, will give a sequence of lines the form and position of which will depend on the position of the reflecting planes and also on the constants of the crystal lattice.

If the axis of symmetry of the crystal lies within the space angle described by the ray, and if it makes a small angle with the perpendicular to the photographic plate, then on the latter will appear a series of hyperbolæ, symmetrically situated, as may be seen on the photograph (Fig. 1). If the orientation

FIG. 1.—Quartz.

of the crystal in relation to the photographic plate is known, the position of the axis in the crystal may be found, and some data may be obtained regarding its structure.

The above-mentioned scheme was realised in the following manner: a system consisting of a rigidly connected photographic plate and a small crystal, placed at a distance of 17 mm. in front of the plate, slowly rotated round the horizontal line passing through the crystal and perpendicular to the plate, and oscillated round a vertical axis which also passed through the crystal intersecting the first one. A horizontal beam of rays emitted by the target of a Röntgen tube passes through a pin-hole placed close before the crystal, through the point of intersection of both axes of rotation, and then is stopped by a small fixed screen situated in front of the photographic plate. This screen prevents the blackening of the plate by the undeflected beam and thus only reflected rays strike the plate and give the above-mentioned picture. The diagrams thus obtained are equivalent to the '*P*-patterns' with an electron beam described by Kikuchi (*Japanese Journal of Physics*, vol. 5, No. 2).

It is obvious that the same picture will be obtained by means of a wide cone of rays emitted from a large radiating surface and passing through the above-mentioned pin-hole. In this case it is not necessary to rotate the plate and the crystal, but the blackening of the plate, caused by undeflected rays, spoils the photographs.

W. LINNIK.

Optical Institute, Leningrad, Oct. 9.

Weitere Beobachtungen über die Dissymmetrie der Emission von Serienlinien.

AN einer früheren Stelle dieser Zeitschrift (NATURE, Juli 27, 1929, p. 125) habe ich eine kurze vorläufige Mitteilung über die neue Erscheinung der Dissymmetrie der Lichtemission im elektrischen Feld veröffentlicht. Im Folgenden seien kurz die Ergebnisse weiterer Beobachtungen über diese Erscheinung mitgeteilt.

Wie ich in meiner Schrift über die Axialität der Lichtemission und Atomstruktur (Polytechnische Buchhandlung A. Seydel, Berlin, 1927) dargelegt habe, stellen die im elektrischen Feld erscheinenden Komponenten der Linien des Wasserstoffatoms Linienserien von bestimmter Charakteristik dar. Von diesen Wasserstoffserien habe ich auf ihr Verhalten in der neuen Erscheinung folgende Linien untersucht: von der Serie $2s - mp^2$ die Linien $3p^2\mathrm{H}_\alpha \pm 1$, $4p^2\mathrm{H}_\beta \pm 6$, $5p^2\mathrm{H}_\gamma \pm 13$; von der Serie $2p^2 - md^3,f^3$ die Linien $4d^3,f^3\mathrm{H}_\beta \pm 4$, $5d^3,f^3\mathrm{H}_\gamma \pm 10$; von der Serie $2s - mp^4$ die Linien $4p^4\mathrm{H}_\beta \mp 2$, $5p^4\mathrm{H}_\gamma \pm 3$; von der Serie $2p^2 - md^5,f^5$ die Linie $6d^5,f^5\mathrm{H}_\delta \pm 6$, von der Serie $2s - mp^6$ die Linie $6p^6\mathrm{H}_\delta \mp 2$. Von allen diesen Linien werden diejenigen, welche vom elektrischen Feld nach Rot verschoben werden, längs der Achse des Feldes entgegengesetzt zur Feldrichtung intensiver emittiert als in der Feldrichtung. Umgekehrt werden diejenigen Linien, welche vom elektrischen Feld nach Violett verschoben werden, längs der Feldachse in der Feldrichtung intensiver emittiert als entgegengesetzt dazu.

Aus dem Spektrum des Heliums habe ich folgende Linien auf ihr Verhalten in der neuen Erscheinung untersucht und zwar in der Achse des elektrischen Feldes wie auch in einer 45° dazu geneigten Achse: für Orthohelium von der Serie $2s - mp^2$ die Linie $3p^2$ λ3889, von der Serie $2p^2 - ms$ die Linien $4s$ λ4713 und $5s$ λ4121, von der Serie $2p^2 - md^3,f^3$ die Linie $3d^3,f^3$ λ5876, von der Serie $2p^2 - md^3$ die Linie $4d^3$ λ4472, von der Serie $2p^2 - mf^3$ die Linie $4f^3$ λ4469, von der Serie $2p^2 - mf^5$ die Linie $5f^5$ λ4025, von der Serie $2p^2 - mp^2$ die Linie $4p^2$ λ4519; für Parahelium von der Serie $2S - mP^2$ die Linien $3P^2$ λ5016 und $4P^2$ λ3965, von der Serie $2P^2 - mD^3,F^3$ die Linie $3D^3,F^3$ λ6678, von der Serie $2P^2 - mD^3$ die Linie $4D^3$ λ4922. Alle diese Heliumlinien folgen in der neuen Erscheinung derselben Gesetzmässigkeit wie die Wasserstofflinien; es werden nämlich diejenigen Linien, welche vom elektrischen Feld nach Rot verschoben werden, entgegengesetzt zur Feldrichtung intensiver emittiert; dagegen werden diejenigen Linien, welche vom Feld nach Violett verschoben werden, in der Richtung des Feldes intensiver emittiert.

Die ausführliche Mitteilung über die vorstehenden Beobachtungen wird voraussichtlich in den *Annalen der Physik* erscheinen. Im Anschluss an sie werde ich die wichtigen theoretischen Folgerungen darlegen, die sich aus ihnen ziehen lassen.

J. STARK.

Grosshesselohe-München, Nov. 18.

Chemical Biogenesis and the Development of Secretion Cells.

AMONG the Research Items in NATURE of Sept. 14, 1929, p. 426, is a note upon an interesting paper recently published by Prof. John Read on "Some Biogenetic Relationships in the Menthone Series".

At the end of the paper referred to in the note (*Chemistry and Industry*, vol. 48, No. 32, p. 786; 1929) Prof. Read says: "The excessively delicate control of molecular transformation which is here implied appears to be a prerogative of the living organism. The organic chemist is powerless to effect such subtle differentiations by artificial means. At the present stage of our knowledge the finer mani-

festations of organic synthesis appear to be inseparably associated with the life-processes."

These statements, which are perfectly true, lead us immediately to postulate that the study of such problems as the origin of terpenes should only be done in close connexion with cytology and cell development. I have made two attempts to study the problem from this side and my results may interest some readers of NATURE.

Studies on the development of secretion cells (Diss., Geneva, 1927) led me to the conclusion that the ideas of Tschirch on this subject are erroneous. Tschirch held that the oil (terpenes) originated from the cell wall by a kind of gelatinisation of the latter; but my experiments on *Asarum europæum*, *Laurus nobilis*, and *Cinnamomum camphora* indicate that the oil (terpenes) is generated directly in the protoplasm. Thus an important chemical conclusion follows from a purely cytological investigation.

Moreover, in a subsequent study of *Persea indica* I have been able to determine the real mechanism of the oil-production (*Planta, Archiv f. wiss. Botanik*, 6 Bd., Heft 2, p. 216; 1928). The oil cells in their youngest stage, when still entirely filled with protoplasm, produce a small drop of a phosphatide-like substance, which is fixed to the cell wall. This 'initial drop', as I call it, serves later on as a membrane to the oil drop. The terpenes originate entirely from the protoplasm without demanding any such intermediate condition as the gelatinisation supposed by Tschirch. At the end of the process the cell is entirely filled with the oil drop, the protoplasm having completely disappeared. The oil drops can easily be detected inside the protoplasm on the spot where they have been formed. The droplets of oil produced thus by destruction of protoplasm are injected into the initial drop. This penetration is only rendered possible by the solubility of the terpenes in the phosphatides. The initial drop then extends, and filling up with terpenes it advances towards other drops in the cell, which are finally all incorporated in the large one. It is also probable that fresh quantities of phosphatides are added to the membrane of the drop as it increases in circumference within the protoplasm. I consider these phosphatides as the active ferments in the destruction of protoplasm (by necrosis or autolysis) and in the synthesis of terpenes. Their presence in the cell walls makes the adhesion of the initial drop easier and even calls for such a formation.

In connexion with these investigations I have formulated the following hypothesis dealing with the synthesis of terpenes in secretion cells.

The protoplasm as a whole is transformed into terpenes (together with phosphatides and perhaps some minor constituents). Thus a destruction of protoplasm has to precede the synthesis of terpenes, and this disintegration certainly leads through the stage of amino-acids. The deamination of amino-acids by the deaminases is a well-known process, which generally leads to the production of an alcohol. If the deamination be incomplete it will result in an aldehyde. *l*-Leucine, one of the most abundant amino-acids, would in these circumstances yield *iso*-valeraldehyde.

This is the point at which my views meet those of Euler and of Kremers. But in my opinion, to derive either *iso*valeraldehyde (Kremers) or methylcrotonaldehyde (Euler) from acetone and acetaldehyde is open to question. These two substances could only derive from the fermentation of sugar, and the amount of sugar in these cells is minute. The aldolisation of aldehydes is a chemical process which must be as easy *in vivo* as it is *in vitro*. The aldolisation of two molecules of *iso*valeraldehyde leads immediately to a terpene with an open chain, and a subsequent internal aldolisation would result in cyclisation.

It will thus be seen that the common origin which Prof. Read recognises for these substances is protoplasmic in nature. It would not be in the least astonishing to find that most of our terpenes are derived from leucine through the intermediate stage of *iso*valeraldehyde. If only one of the many terpenes were produced by this method, the others could derive from it by aldolisation, methylation, hydration, oxidation, and other recognised natural processes.

Our present knowledge of the problem indicates the desirability of further investigation, and the results of Prof. Read's chemical work will be awaited with interest. I shall myself continue the work on the biological side.

A. LEEMANN
(Plant Pathologist to the Botanical Survey of South Africa).
P.O. Box 1086, Pretoria.

Variations of Intensity Distribution of the Auroral Spectrum and the Possible Influence of Sunlight.

IN a letter which appeared in NATURE of Aug. 17, 1929, p. 263, Prof. C. Størmer described some spectrograms, which he, together with Mr. Moxnes, had taken from sunlit auroræ and auroræ in the earth's shadow. From the spectrograms, Størmer draws the conclusion that the intensity of the auroral line relative to that of the negative bands for sunlit auroræ is much smaller than that found for aurora in the earth's shadow.

I do not think that from Størmer's experimental material we can draw any conclusion as to the possible

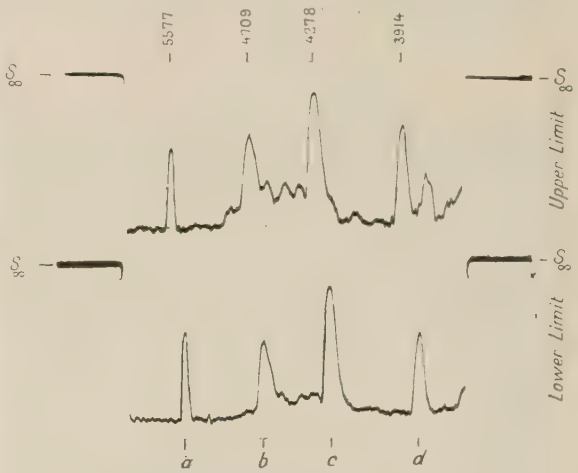

FIG. 1.—Registrams of aurora spectra taken on Mar. 25, 1923. Difference of height about 60 km.

influence of sunlight on the intensity distribution of the auroral spectrum. First of all, the two spectra given by Størmer do not fulfil the conditions which make them comparable, and are necessary for photographic evaluation of changes of intensity distribution, because the two spectra are taken on different plates; but the most serious defect of the material is that one of the spectra is very strongly exposed, while the other auroral spectrum is very weak.

Even in the spectrum corresponding to the earth's shadow the green auroral line has a smaller photographic density than the three principal nitrogen lines. In the spectrum of sunlit auroræ, the weakest of the nitrogen lines, 4709, is just visible on the plate, and then on account of the threshold effect we should expect the auroral line to be extremely faint even if no change of intensity distribution takes place.

Secondly, even if the spectrograms might show an effect qualitatively in the direction indicated by Størmer, we should not be able to take this as an

argument for the effect of the sunlight, for in his experiments an eventual sunlight effect would be mixed with a very considerable variation of intensity distribution, discovered by me in 1923 (*Phil. Mag.*, **46**, p. 577 ; 1923), which was measured accurately under the most favourable photographic conditions (see article on auroræ, " Handbuch der Physik ", Bd. 25, p. 385). It was then found that the intensity of the auroral line relatively to that of the auroral nitrogen lines (4709, 4278, 3914) diminished considerably with increase of height. The effect is clearly shown in Fig. 1, giving registerings of two spectrograms on the same plate corresponding to a difference of altitude of about 60 km. For the lower limit, the auroral line 5577 gives a greater density than 4709, while at the upper limit the densities are inversed. Quantitative measurements gave the result that $\frac{(a/b)\text{ upper}}{(a/b)\text{ lower}} = 0{\cdot}695$ on a pair of spectra from one plate, and 0·76 on a pair from a second plate ; a and b are the intensity of the auroral line and that of one of the nitrogen lines respectively.

Now Størmer's spectra correspond to differences of altitude of 200 km.-300 km., and from the variation with altitude alone we should, in the case considered by Størmer, expect to find $\frac{(a/b)\text{ sunlit}}{(a/b)\text{ shadow}} = \text{about } 0{\cdot}3$, which would mean a very great intensity variation. Thus, even if it had been possible from Størmer's material to conclude that the sunlit aurora gave a relatively weaker auroral line, this effect might be due merely to the altitude effect I discovered in 1923.

L. VEGARD.

Oslo, Nov. 15.

A Haploid *Œnothera*.

A SINGLE haploid *Œnothera* occurred this year in a culture of F_1 hybrids which were non-viable, and this result is of such interest as to deserve a separate record.

In 1927 reciprocal crosses were made between *Œnothera rubricalyx* and *Œ. eriensis*, both of which have fourteen chromosomes. *Œ. eriensis* × *rubricalyx* gave a uniform F_1 with the red pigmentation of *rubricalyx* and the small flowers of *eriensis*. They bred true in F_2 and were strongly patroclinous except in flower size.

The reciprocal cross, *rubricalyx* × *eriensis*, made at the same time, produced a potful of seedlings which were yellowish in colour, developed a little chlorophyll, and then promptly died when their stored nourishment was used up. The striking non-viability of this hybrid type led to a repetition of these crosses in 1928 with the same results. The *rubricalyx* × *eriensis* gave from one capsule 21 small and feeble seedlings, all of which died off simultaneously, showing a lethal effect. From another capsule, obtained by crossing different individuals of the same two species, 85 seedlings were obtained. They behaved in the same way as the preceding, except that two of the seedlings managed to survive for a time and one lived long enough to be planted out. It reached maturity and belonged to a new type, very much dwarfed and completely sterile as regards pollen and seed production.

It was predicted that this plant might be a haploid, and such has proved to be the case, as it has only seven chromosomes in its somatic cells. The plant showed the red pigmentation of *rubricalyx*. Its leaves were small, narrow, and rather pointed, and these were regarded at first as resemblances to *Œ. eriensis* ; but it seems more probable that these are characters pertaining to haploid *rubricalyx*.

As regards the origin of this haploid mutant, it appears to have developed parthenogenetically from a *rubricalyx* egg under the stimulus derived from the foreign pollen tubes of *eriensis*. The great bulk of the seedlings, which were non-viable, appear to have been true (diploid) hybrids with *eriensis*.

The first haploid sporophyte in higher plants was discovered by Blakeslee in 1922 in the offspring of *Datura* plants which had been subjected to low temperature at about the time of fertilisation. Other cases of haploids have since been found in *Nicotiana*, *Triticum*, *Crepis*, *Solanum nigrum*, and recently in the tomato. They have usually resulted, like the above, from crosses between two distantly related species with a high degree of interspecific sterility. In the present instance, the sterility appears to be complete when the cross is made one way, while the reciprocal cross produces plenty of viable seedlings.

A full account of this haploid mutant will be published later. R. RUGGLES GATES.

King's College,
University of London, Dec. 2.

The Perfect Elasticity of Wool.

THE most striking property of the wool fibre is its ability always to return to its original length after stretching in cold water. If, however, a fibre is steamed in the strained position, it shows no tendency to return to its original length in cold water. So far as I am aware, it has hitherto been found impossible to induce such fibres to return to their original length, although *partial* recovery occurs on re-steaming in the absence of tension. During the course of another investigation, however, I have recently found that fibres which have taken a permanent set of the kind just described, recover the property of perfect elasticity in caustic soda solutions. For example, a fibre which had been stretched and steamed for 15 minutes at 47·4 per cent extension, returned to its original length in 14 minutes in 0·15 *N* caustic soda solution. Contraction does not cease when the original length is attained, but continues beyond this point until a real shrinkage of about 10 per cent of the original length is observed. The rate of recovery increases with the strength of the solution, but is measurable even in 0·01 *N* caustic soda. The discovery opens up a number of possibilities in regard to ' finishing ' processes in the wool textile trade, but of even greater significance is the contribution which it makes to knowledge of the elastic phase in the wool fibre and the changes which it undergoes during stretching and steaming. Complete details of the results and conclusions of the investigation will be described in another place. J. B. SPEAKMAN.

The University, Leeds, Nov. 28.

Continents and Oceans.

As the result of my letter on " Continents and Oceans ", which appeared in NATURE for Nov. 30, several correspondents have directed my attention to Lothian Green's ' tetrahedral hypothesis '. This hypothesis was devised to explain why the continents have oceans at their antipodes, and Prof. J. W. Gregory has given an excellent account of it in his little book entitled " The Making of the Earth ", published in 1912.

I am sorry that I had not seen Prof. Gregory's book before I wrote my letter, as it would have helped me to emphasise the point which I wished to make ; for the object of my letter was not to describe new relationships between the continents and oceans, but to direct attention to the necessity for taking the relationships which I described into account when discussing Wegener's hypothesis. G. C. SIMPSON.

Meteorological Office,
Air Ministry, Kingsway, W.C.2, Dec. 5.

The Proposed New 200-Inch Telescope.

IT is now common knowledge that plans for the construction of a 200-inch reflecting telescope are being worked out at Mount Wilson observatory. This enterprise has been rendered possible by the generosity of the International Education Board, which in May 1928 authorised its executive committee to provide for the construction of an astrophysical observatory equipped with a 200-inch reflecting telescope and auxiliary instruments. The proposed new observatory is to be conducted in close co-operation with Mount Wilson and the increased light-collecting power of the 200-inch telescope should permit further studies of the size and structure of the galactic system, of the spectra of the brighter stars under very high dispersion, and of many other important problems. A short account of the plans for the 200-inch in so far as they have matured will interest many readers of NATURE. More complete details are given by Prof. Hale in an article in the November number of *Harper's Magazine*, the source from which the substance of the present article has been drawn.

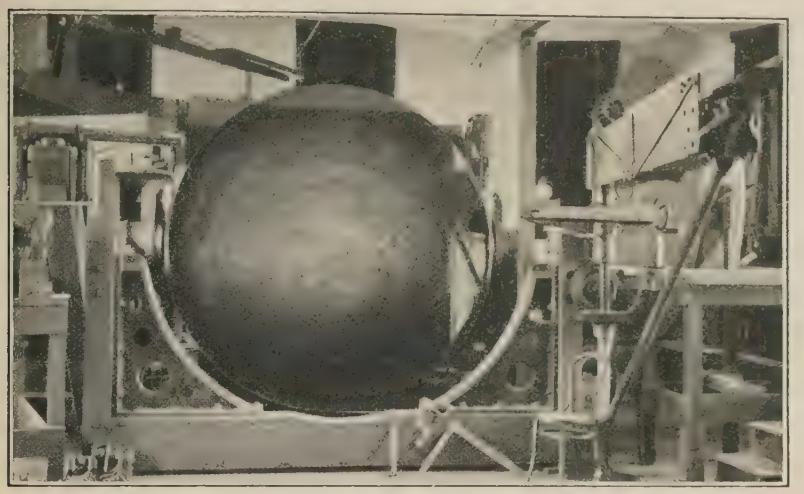

FIG. 1.—The 101-in. mirror in the vertical position for optical testing.

In the construction of the new instrument the experience gained in constructing the present 100-inch instrument at Mount Wilson will naturally be of great assistance, and it will be helpful to recall some of the difficulties met with in the construction of the smaller instrument. The greatest troubles were in the construction of the mirror itself. It is obviously desirable to secure a disc of glass which is free from internal flaws, but in the case of the 100-inch the disc which was finally used was one which was delivered in 1908 and was rejected at the time. It was only after further attempts to produce a suitable disc had failed that the present mirror was figured from this rather unsatisfactory disc. The disc in question was full of bubbles, as can be seen from Fig. 1, which is reproduced from a recent memoir by G. W. Ritchey.[1]

[1] "The Development of Astro-Photography and the great Telescopes of the Future." Publié sous les Auspices de la Société Astronomique de France. 1929.

The chief difficulty in the construction of very large discs of glass arises from the fact that they suffer devitrification during the weeks or months required for the slow cooling known as annealing. This leads to loss of rigidity—a serious defect. Furthermore, glass is a poor conductor of heat and consequently the outer parts of a large silver-on-glass mirror change in temperature more rapidly than the inner. The curvature of the surface is thus affected, and this means that the stellar image, instead of being nearly a point, may often be expanded into a much less brilliant disc. This defect can in the case of existing mirrors be partially removed by the provision of constant temperature water jackets and a similar plan might conceivably be adopted in the case of the 200-inch, but the difficulties clearly increase with size. It seems probable that a limit has already been reached in the construction of large mirrors of solid glass.

Prof. G. W. Ritchey has recently advocated the construction of cellular mirrors, constructed by building up a kind of honeycomb from thin glass plates, and this plan has been considered at Mount

FIG. 2.—Tentative model of 200-inch telescope for the California Institute of Technology. Made by the Warner and Swasey Company after preliminary designs by E. P. Burrell and Francis G. Pease.

Wilson by Prof. Hale and his collaborators. Its adoption, however, has not been favoured, on account of the difficulty of figuring with optical perfection the thin glass faces and the edges of the honeycomb structure. In addition, doubts have been entertained as to the optical permanence of a heavy cemented structure subjected to wide ranges of temperature.

The plan which at the present moment appears most promising to the astronomers concerned is to make the mirror of fused quartz, a substance which possesses a very small temperature coefficient. The process consists of fusing a mass of nearly pure silica in a circular electric furnace which constitutes the mould. The disc thus obtained contains a large number of small bubbles, but it can be ground to the approximate curvature of the mirror desired and then coated to a sufficient thickness with perfectly transparent quartz free from bubbles. The final figuring is then carried out on the surface of this clear layer. The quartz composing the clear layer is sprayed on to the hot disc by means of multiple oxy-hydrogen burners. A 22-inch disc has already been constructed in this way, and it is now proposed to make a 60-inch mirror before finally embarking on the construction of the 200-inch mirror itself.

With regard to the figure of the mirror, it has been decided to construct it with a focal length of 55 feet, that is, with a focal ratio of f 3·3. The use of such a small focal ratio will give an immense concentration of light, but in common with all short focus mirrors the field of good definition will be small. It is proposed to remedy this defect by the use of a correcting lens, designed by Dr. F. E. Ross, which will be placed immediately in front of the photographic plate at the principal focus of the 200-inch mirror. Dr. Ross has in addition to this computed a correcting lens which will, it is hoped, reduce the equivalent focal ratio to f 2·2. Provision will also be made for a Cassegrain arrangement with an equivalent focal ratio of f 10. The convex mirror in this arrangement will be 60 inches in diameter.

The telescope will be mounted equatorially. The problem of the mounting will be an engineering enterprise of no mean dimension, and the lessons learnt and the difficulties met with and overcome in the mounting of the existing 100-inch telescope will doubtless be invaluable in this connexion.

Considerable attention is being paid to the selection of a suitable site. It is highly important that the efficiency of the 200-inch should not be impaired by poor seeing arising from atmospheric tremors. The experience gained with the 100-inch has shown that at Mount Wilson itself a 200-inch telescope could be depended upon to show a gain in keeping with its increased size. It is, however, probable that a still better site can be found in California, and the possibilities are being explored by observations at various sites with portable telescopes.

One of the proposed models for the 200-inch telescope, which is now on exhibition in the building of the National Academy of Sciences, Washington, D.C., is shown in Fig. 2. It should be mentioned that the plans include the provision of an adequate laboratory and workshop. W. M. H. G.

The Locust Problem.

By Dr. A. D. IMMS, F.R.S.

THE theory of the phases of locusts, advanced by B. P. Uvarov in 1921, is now well known to entomologists and has proved a fertile stimulus to further investigation of this important problem. It recognised the existence among these insects of two definite or extreme forms—one gregarious and the other solitary — which are connected by a continuous series of less defined transitional forms. Messrs. B. P. Uvarov and B. N. Zolotarevsky[1] have recently discussed certain aspects of the problem, in the light of new observations made by S. A. Predtechensky in Russia, and by the junior author in Madagascar. Although their remarks apply more especially to the well-known species *Locusta migratoria*, these authors believe that a standard phase nomenclature, applicable to all species, would be both possible and advantageous. According to their interpretation a locust can exist in three unstable biological phases, namely, a solitary one, *phasis solitaria*: a gregarious one, *phasis gregaria*, and a transitional phase between these two which they term *phasis transiens*. These phases differ from each other in morphological and colour characteristics, on one hand, and in biological features (mainly behaviour) on the other. Whether it will prove possible to distinguish such phases solely by the convenient method of examining their morphological characters, can only be determined by studying the whole series of phases of a given locust in a specific locality.

The solitary phase consists of isolated individuals and is represented where no swarms exist, or have existed, within at least one preceding generation. The transient phase is not represented by any definite form, but by a continuous series of transitional forms between the solitary and gregarious phases. Such a series may be observed either (*a*) when the transformation is from the solitary phase towards the gregarious phase, when it may be termed *phasis congregans*; or (*b*) the tendency is in the opposite direction, when it is termed *phasis dissocians*. These two phases are, therefore, essentially of a biological nature, but it appears that it may be posssible to distinguish them also by minor details of structure and colour. The gregarious phase is that assumed when individuals form dense and extensive emigrating swarms (Fig. 1). Recent studies of *Locusta migratoria* have shown that, although this species is a very

[1] Phases of Locusts and their Interrelations. *Bull. Entomological Research*, **20**, pp. 261-265, Oct. 1929.

definite unit, it exists as three subspecies, namely, *rossica* in Central Europe and possibly Western Europe, *migratoria* (*sensu str.*) in south-east Russia and *migratorioides* in the tropics and subtropics. Each of these subspecies may pass through the three phases already mentioned, but it is possible that all may not prove to be equally polymorphic. The application of this theory to other species indicates that, in the past, the solitary and gregarious phases being in most cases so distinct they have hitherto not been recognised as such. Great confusion has naturally resulted, since they have been regarded as distinct species under separate names. From the practical point of view of locust control it is, obviously, of prime importance to study the behaviour of these insects in the light of Uvarov's theory. The theory lends a new interpretation of the causes of locust outbreaks, and by directing research along a defined course it will co-ordinate investigation, hitherto largely prosecuted blindly in the hope of eventually alighting upon some solution of the problems concerned. It opens up the possibility that transformation of locusts into the gregarious phase may sometimes be circumvented, and the location of the breeding grounds of the latter phase may lead to the destruction of immense numbers of potentially harmful individuals. This aspect of the subject is fully discussed in Uvarov's recent treatise [2] on locusts, which has already been noticed in these columns.

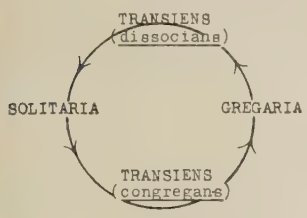

FIG. 1.

On April 29 of this year the chairman of the Committee of Civil Research [3] appointed a scientific sub-committee of ten members under the chairmanship of Sir Henry Miers, with the following terms of references :

" To consider and report on :

(*a*) Means for the mass destruction of the Desert Locust *Schistocerca gregaria* Forsk.

(*b*) Methods for ascertaining the reasons for the periodic swarming of this species with a view to its control."

The depredations of the Desert Locust are of immediate concern to the Empire, since an enormous area of British Africa is periodically affected besides Palestine, Transjordania, and Iraq. In Kenya, for example, it is mentioned that £50,000 has already been spent on control and relief measures with respect to an outbreak of this insect which is still continuing at the present time. The Kenya government has now taken power to prohibit all exports of foodstuffs from the territory, and the Legislative Council has passed a resolution authorising expenditure up to £200,000 to the Food Control Board to enable it to discharge its function.

As a preliminary step the Committee of Civil Research has issued two reports of the Locust Sub-Committee which were presented to Parliament in July 1929. In the first report it was recommended that the collection of information from all available sources respecting the habits and behaviour of the Desert Locust should be proceeded with forthwith. This information should be collated and distributed to the territories affected by the insect in question. In order to effect this scheme, it was recommended that financial arrangements should be made to enable the Imperial Bureau of Entomology to commence this work. In its second report the Sub-Committee drew up a draft scheme of the research it deemed necessary to be carried out, and stress was laid upon the possibility of employing aeroplanes for purposes of reconnaissance and perhaps also for the destruction of locusts. It recommended that colonial governments, interested in this specific locust problem, should be communicated with and invited to indicate whether they would assist by contributing to the cost and by providing local facilities if a proportional Imperial contribution could be arranged. It also suggested that communication, in a similar sense, should be made for the purpose of obtaining the views of the Government of India. With the object of obtaining the fullest information possible respecting the Desert Locust, it is further suggested that inquiries should also extend to foreign territories affected by the insect in question.

About the middle of the present year evidence of the enormous destruction occasioned by the Desert Locust in Palestine had come to hand in the form of an article by Mr. G. E. Bodkin,[4] Government Entomologist. The history of locust invasions in Palestine indicates that these visitations have occurred in recent years with remarkable regularity. Thus 1865, 1878, 1890, 1902, 1915, 1928 are marked by visitations of this insect—an unvarying period of 12-13 years elapsing between the events. The year 1915 was a most disastrous one, and in the Jaffa district alone damage to the extent of about £200,000 is stated by Mr. Bodkin to have resulted from locust depredations. Since the destruction was practically universal in Palestine the damage in the whole country reached a colossal figure. The suffering endured by the population, as it happened, was alleviated to a marked degree by the War, which involved the occupation of Palestine by the British army. The large supplies of food thus brought in, and the liberal payment for services rendered, helped the population at a time when it was demoralised by the destruction of a means of livelihood.

Palestine was visited by another invasion in 1928, and the chief facts respecting this event are recounted in Mr. Bodkin's article. It appears that there were three successive waves of invasion, but, by comparison with the event of 1915, they were but light. Ability to anticipate such an occurrence resulted in very little serious damage being incurred. The appearance of the Desert Locust in Hauran and in Egypt the previous year gave timely

[2] "Locusts and Grasshoppers." London, 1928.

[3] Committee of Civil Research. Locust Sub-Committee. First and Second Interim Reports. London. H.M. Stationery Office, 1929. Price 3*d*. net.

[4] "The Locust Invasion of Palestine during 1928." *Bull. Entomological Research*, **20**, pp. 123-139, Aug. 1929, with 3 text figs. and 3 plates.

warning, and preparations for a control campaign the following year were soon embarked upon. Consequently, 1928 was the first time that locust invasions in Palestine were combated with an adequate organisation of material, equipment, and personnel. The campaign was assisted by the drought, which rendered the ground unsuitable, for the most part, for the insects to lay many of their eggs.

The nature of the control measures that were applied can only be briefly mentioned here. The destruction of the winged locusts, prior to egg-laying, means the elimination of hordes of potential young locusts, and Mr. Bodkin describes a type of flame-thrower devised for this purpose. These machines did good service at night owing to the habit of the Desert Locust of clustering in dense masses at that time. The arming of large numbers of villagers with hand nets resulted in further destruction, and they also assisted by encircling swarms of gravid locusts, and slowly driving them to a common centre, to be exterminated by use of flame-throwers. The methods prosecuted were so efficient that most of the egg-laying became restricted to the Jericho district. The resulting young locusts or 'hoppers' were destroyed by spraying with kerosene emulsion, and later by fire and by means of arsenicals. Mr. Bodkin's instructive and timely report should do much to encourage those who have to encounter the same menace in other lands. It is evident that adequate preparation, and the application of the right measures coupled with a knowledge of specific locust behaviour, were collectively responsible for the good results achieved.

The Palestine outbreak is directly related to a much more formidable and simultaneous invasion by the Desert Locust of the southern Sudan, Kenya, and Tanganyika Territory. The duration of this menace cannot be foretold with certainty, but it appears probable that it will continue until 1931. The reports of the Committee of Civil Research synchronise, therefore, with a recurrent outbreak of first magnitude. This fact should serve to stress the urgency of carrying out the procedure advocated with as little delay as possible. A judicious expenditure of £20,000 or £30,000 in the course of four or five years should reap benefits out of all proportion to the money so devoted. The greatest need is for exact information on the behaviour and habits of the Desert Locust, and the co-ordination of such information from as many sources as possible. Without this knowledge, we shall be merely groping in the dark for many years to come simply because there is no adequate foundation to work upon.

Irradiation and Health.

THAT exposure to sunlight or some source of ultra-violet, luminous, or heat rays has a beneficial effect upon general health has been claimed by many competent observers. That insolation is of great value in the treatment of various forms of tuberculosis may be taken as well established, although the cooling power of the open air, as well as the sun's rays, plays a part in the favourable effects produced. Again, that vitamin D is formed from ergosterol in the skin when the latter is exposed to ultra-violet light has been definitely shown, as well as the development of an increased bactericidal power in the blood, after suitable irradiation of the same organ. But whether such effects are accompanied by an increase in the resistance of the body to infection has not been satisfactorily demonstrated, in spite of a very general impression that suitable exposure to a source of light does improve the general health. Colebrook [1] has therefore submitted this question to an experimental study, and at the same time has investigated the influence of light upon the rate of healing of a purely local infection.

In the first investigation the influence of light upon the health and development of school children was studied: their ages ranged from five to seven years, and the period of observation extended from August 1927 to March 1928. They were divided into three groups, upwards of a hundred children in each: one acted as a control, the others were exposed, clad in bathing slips only, three times weekly to a direct current long-flame carbon arc lamp; in one of these the light from the lamp was screened by glass, so that only rays longer than about 3342 A. reached the children. The dosage aimed at was one which would just fail to give an erythema reaction on the skin of a child of average sensibility: it was gradually increased by diminishing the distance of the child from the lamp, by increasing the time of exposure, and also the output of the lamp. Pigmentation of the skin was produced in a number of the children by the treatment. The groups were selected to be as similar as possible as regards ages and types, and it was considered that the home conditions were, on the average, also similar in the groups and were such that any benefit due to the irradiation would be easily seen and not counteracted by a poor home environment.

The progress of the children was followed by recording height and weight at intervals, by frequent observations of the occurrence of chilblains and colds, or other infections, and by noting the subjective impressions of the medical officer, teacher, and parent. The results were, in brief, that exposure to light had almost no beneficial effects whatever: in fact, the advantage was usually to the control group as compared with the lamp groups, or to the screened lamp group as compared with the unscreened. However, as regards progress in schoolwork, exposure to light, especially the screened lamp, appeared to be of favourable influence, whilst the unscreened, and

[1] Medical Research Council. Special Report Series, No. 131: Irradiation and Health. A: Ultra-Violet Irradiation of School Children; B: Irradiation of Varicose Ulcers. By Dora Colebrook. Pp. 47. (London: H.M. Stationery Office, 1929.) 1s. 6d. net.

to a certain extent the screened, lamp seemed to exert at first a stimulating effect on increase in weight, although this stimulus was only temporary in its action, and the period of increased growth was followed by one of relatively decreased growth rate, so that at the end of the experiment the advantage was with the control group. As regards infections, the evidence was definitely against the exposure to light having any favourable effect, but, for what they are worth, the subjective impressions of teachers and parents were in favour of the lamp groups.

It thus appears that, except for a possible temporary stimulating effect upon growth, exposure to light is without influence upon bodily states which are susceptible of objective measurement, but may be taken to improve, although only slightly, that state which can only be described as the general health and well-being. It may be emphasised that these conclusions only apply to the conditions of this particular experiment, and that other sources of light, etc., might have different effects; that the home conditions of the children were uncontrolled (though probably sufficiently similar in all the groups), and finally, that the control group differed from the others not only in not being exposed to light, but also in not sharing the necessary routine incidental to this exposure, such as withdrawal from lessons, dressing and undressing, and exposure to the different temperature of the lamp room as compared with the class room.

In the second study, Colebrook investigated the influence of ultra-violet light from mercury vapour lamps upon the healing of varicose ulcers: either the leg up to the knee or the ulcer itself only were irradiated; between treatments only a simple dressing and bandage were applied. For controls, a series of cases was treated with Unna's zinc oxide and glycerine paste. The result of the investigation was that the cases treated with light of very varying intensities responded much less satisfactorily than those dressed with the paste: the difference was most marked in the case of the ambulant patients, indicating that any benefit seen under light treatment in patients kept in bed was probably largely due to the accompanying rest and not to the light. No difference was observed in the course of healing between irradiated and unirradiated areas of the same ulcer, other conditions being the same for both: and finally, relief of symptoms was not obtained during light treatment but was a marked feature in the patients treated with Unna's paste.

Obituary.

DR. HAROLD WAGER, F.R.S.

DR. HAROLD WAGER, whose death occurred on Nov. 17, had shown his interest in science at an early stage in his career. In 1885 he was associated with Mr. Auberon Herbert as private secretary, an association which led to their collaboration in the production of a paper in the *Contemporary Review* upon "Bad Air and Bad Health", which afterwards appeared (1894) as a pamphlet. From 1886 onwards Wager went to the Royal College of Science, where he was a regular attendant at Dr. D. H. Scott's classes upon botany, and is still remembered by the latter as one of his most brilliant students.

In 1888, Wager was appointed demonstrator in biology in the Yorkshire College at Leeds. Since that date, although he has not always resided at Leeds, he has been so much identified with both science in Yorkshire and with the Yorkshire College —and afterwards the University of Leeds—that he is generally recognised as one of the most distinguished of a very remarkable band of scientific naturalists of the county of the broad acres. In 1894 he married Winifred Miall, the only daughter of Prof. L. C. Miall, the first and only professor of biology in the Yorkshire College.

On the outbreak of the War, with the consent of the Board of Education, Dr. Wager voluntarily undertook the direction of the Department of Botany during the absence of Prof. J. H. Priestley upon war service. After the armistice he remained for some time in contact with the Department, in which he held an honorary lectureship, and it was with regret that the University Council recently received his resignation of that post when he found himself unable to keep in touch with the activities of the Department.

Through his early association with Dr. D. H. Scott, some of Wager's earliest scientific papers were upon plant anatomy, including a paper, in collaboration with Dr. Scott, upon the floating roots of *Sesbania aculeata*, but throughout his career Wager showed a catholic diversity of interest—every subject open to experiment and observation in the scientific spirit being of appeal to a man with the temperament of the naturalist and observer, and the training and technique of the student of science. He first established his scientific reputation by a long series of papers upon the cytology and life-history of the fungi, which were published during the years 1889–1900. Early in the new century he was also making observations upon the cytology of the blue-green algæ, the Cyanophyceæ; but what distinguished Wager as a student of such problems was that he never lost interest in the growing plants in the field. As a result his specialist studies of these two groups have the very unusual accompaniment that he has published in the *Naturalist* keys to the determination of species of Oscillatoria and Phormidium, and also a very useful guide to the determination of genera of the Agaricaceæ.

This interest and sympathy with the field of work of the naturalist, coupled with his specialist knowledge of technique in fields usually outside the naturalist's province, made Wager a great influence in deepening and extending the contribution of Yorkshire naturalists to biology. Under his

chairmanship the annual mycological forays of the Yorkshire Naturalists' Union have done very successful work in promoting interest in these plants, and in adding to our knowledge of the Yorkshire species. In 1913, as president of the Union, he devoted his address to a brief résumé of his observations upon the movements of free-swimming micro-organisms, a fascinating subject which showed him at his best, alike as a naturalist and as a brilliant manipulator of microscopic living organisms, alive to the fact that the infinitely small amongst living creatures still have to obey physical laws.

On the occasion of the meeting of the Yorkshire Naturalists' Union in Leeds in 1914, the University conferred upon him the honorary degree of D.Sc. in recognition of his great contribution to science and his distinguished association with the study of natural science in Yorkshire. In 1904 he had been elected a fellow of the Royal Society.

Dr. Wager's severance from academic laboratories, upon his appointment as one of H.M. Inspectors of Secondary Schools, in no way diminished his scientific activity. With simple laboratory appliances, but with an almost uncanny *flair* for microscopic manipulation, he continued to carry out observations in various fields of biology, and in particular turned his attention to a number of problems of plant physiology. His photographs through the lenses of the leaf epidermis were as beautiful a demonstration of the capacity these cell wall structures showed to focus objects, as his experiments were to show that Haberlandt's views as to the function of the 'ocelli' needed revision. He also made numerous observations upon the leaf pigments and other plant pigments, many of which, probably, have never been fully embodied in his published writings.

These unremitting scientific labours were a daily accompaniment to Wager's conscientious fulfilment of his duties as an inspector of schools. The result was, naturally, that the teacher of biology in the school, apt to have recourse to the easier path of instruction through text-book and diagram, was constantly being reminded of the wide gap that may exist between the formal description and the object awaiting the unprejudiced regard of the observer. Just as the amateur naturalist, seeing in Wager a kindred spirit, was led by his example to take more pains and extend the range of his scientific technique, so the professional teacher was encouraged to leave routine repetition of second-hand facts, to observe for himself, to become, in fact, a naturalist, and thus to develop a new enthusiasm which rapidly communicated itself to his pupils.

During Wager's long association with Yorkshire, he learnt to love the Yorkshire dales. It was in his cottage in Lyttondale that he died after a short illness, and he was laid to rest in the little churchyard at Arncliffe amongst associations that were always dear to his memory, and to those of his many Yorkshire friends. There they will like to think of him—at rest in surroundings that were always congenial to his spirit.

Sir Sainthill Eardley-Wilmot, K.C.I.E.

The death of Sir Sainthill Eardley-Wilmot on Nov. 13, at Henley-on-Thames, removes a great forester who spent forty-seven years of his life in the service of his country. Eardley-Wilmot was the fourth son of Augustus Hillier Eardley-Wilmot, and was born on July 17, 1852. He joined the Indian Forest Service in December 1873, after having spent three years undergoing his forestry training in Germany. There can be little doubt that some aspects of this training had a considerable influence on Eardley-Wilmot's subsequent career: for he was able to appreciate to the full the advantages, as also the weaknesses, of a purely German training, when strictly applied, to the very dissimilar and varying conditions of the sub-tropical and tropical forests. Wilmot was appointed to the old North-West Provinces and Oudh, spending the first sixteen years of his service as an executive officer in charge of several forest divisions in the Provinces. In 1890 he was promoted to administrative rank and passed the following eight years as Conservator in Oudh, where his organising ability, combined with his great professional knowledge, radically changed the management of the forests by introducing a more scientific conservancy and earned him the encomiums of the local government.

It was during this period that, as a result of sylvicultural studies carried out in the forests, Eardley-Wilmot wrote a series of important papers entitled "Notes on the Regeneration of the Sál (*Shorea robusta*)"; "Notes on Sál Forests"; "Notes on Improvement Fellings"; "Sál Coppice Forests of Oudh"; "Notes on the Treatment of Shisham (*Dalbergia Sissoo*) and Khair (*Acacia Catechu*) in the Sub-Himalayan Tracts"—all of which were published in the Appendix Series of the *Indian Forester* in the nineties of last century. They formed a very valuable addition to the scanty knowledge at the time existing on the sylvicultural characteristics of these species. From 1900 until 1902 Eardley-Wilmot was in Burma, and in February 1903 was appointed to officiate as Inspector-General of Forests, and afterwards confirmed.

Apart from numerous activities in administrative directions, notably the improvements he was able to get effected in the emoluments of officers of the Department of all grades, and the steps he took to improve the forest education of the executive and provincial staff of the Department in India, Eardley-Wilmot's greatest achievement was connected with the inauguration of the Imperial Forest Research Institute at Dehra Dun. At the time Eardley-Wilmot passed through Calcutta *en route* for Burma, the then Inspector-General of Forests, Mr. B. Ribbentrop, was endeavouring to obtain the consent of Government to the appointment of a forest officer to take up special research work in forest entomology. Eardley-Wilmot was keenly interested in this new departure. The appointment applied for was made for two years, and I myself took up the work. At the end of the period the question of continuing the work was undecided. I was in charge of the Indian Museum as officiating

superintendent, and Eardley-Wilmot came back to Calcutta from Burma. This was in February 1903; and the first of many conversations then took place between the Inspector-General of Forests and myself on the subject of the formation of a Forest Research Institute. Lord Curzon was Viceroy, and once Eardley-Wilmot had obtained his sympathetic consideration, the matter went through and the Institute was inaugurated in 1906, six research posts being filled by officers selected from the Forest Department. The Inspector-General often said that his reply to the query as to where he was going to obtain his research officers, "From the Department, sir", pleased the Viceroy almost more than any other incident in connexion with the new departure. For Lord Curzon was the Viceroy who really commenced the introduction of the scientific expert into India, and it proved a difficult work at first to obtain suitable men. The research officers were appointed and commenced work. But there were no buildings and no equipment. All that had to come. The opening by the Viceroy of the greatly enlarged Forest Research Institute at Dehra Dun (NATURE of Nov. 16, p. 778), but six days before Eardley-Wilmot's death, is a witness to the enormous value of the step taken in 1906.

Eardley-Wilmot left India in 1908 on furlough, retiring from the service in 1909. His work was not finished. For he was appointed in 1910 as one of the Commissioners of the newly formed Development Commission, forestry being his special charge. With his Indian experience behind him, he determined that forestry education was one of the first lines to take up in Great Britain. Grants for this purpose were made to various institutions. Edinburgh received a grant from the Development Commissioners of £10,000. The larger part of this grant was made with the object of erecting suitable departmental buildings (we only had two cellars in the old University buildings at the time), the University Court adding a similar sum. A further grant was offered to enable a chair to be established, and this sum also eventually materialised. At the end of five years as a Development Commissioner, Eardley-Wilmot was appointed forestry adviser to the Commission and held the appointment for five years. At the end of this period the Forestry Commission came into being and took over charge of forestry work from the Development Commission. This ended Eardley-Wilmot's active life as a forest officer.

It is perhaps too soon to adjudicate correctly upon the value of Eardley-Wilmot's ten years' work for forestry in Great Britain and Ireland. The Development Commissioners had no executive powers; grants were given in the interests of afforestation and a commencement had been made with the introduction of a system of co-operation between landlord and State in the formation of new plantations on a profit-sharing basis. For the purpose of this review of Eardley-Wilmot's life's work, he will be remembered for the part he played in bringing the Forest Research Institute into being in India, and—what he himself would value as a still stronger claim—he will be remembered as a fine forester and magnificent sportsman. His "Forest Life and Sport in India" is regarded as a classic as much from the scientific forestry viewpoint as from a natural history and sporting one. He also published two other books, "The Life of a Tiger" and "The Life of an Elephant", both of which gave evidence of a close study of the lore of the jungle.

E. P. STEBBING.

MR. W. R. BOWER.

THE death occurred at his home at Huddersfield, on Nov. 20, of Mr. William Richard Bower, who was for more than thirty years head of the Physics and Electrical Engineering Department of the Huddersfield Technical College.

Mr. Bower was born at Southampton and received his early education at the Taunton School and the Hartley College in that town. Gaining a national scholarship, he proceeded to the Royal College of Science, London, of which he became an associate and later a member of staff. Before the commencement of his long period at Huddersfield in 1896, he served on the staffs of the University College of Wales, Aberystwyth, and Brighton Technical College. He was a fellow of both the Physical Society and the Institute of Physics, and, after his retirement, received the honorary title of emeritus professor of physics at Huddersfield Technical College. His breadth of knowledge, attention to detail, and great experience as an experimentalist gave a marked impress to his teaching and brought him the warm affection of his students.

Amongst Mr. Bower's early activities at Huddersfield was the practical application of X-rays, in which he was a local pioneer; many and varied were the cases then brought to the College for examination. Later, as a writer, he was joint author of Bower and Satterly's "Practical Physics" and author of "Primary Physical Science" which appeared last year. He was especially interested in optics and published papers illustrating the application of graphical and geometrical methods.

Mr. Bower's steadiness of aim, disinterested sincerity, and great capacity for administrative work led him to take active interest in the Association of Teachers in Technical Institutions. He served on the national executive of this body for many years, and, at a critical period in the history of the teaching profession, became president of the Association and a member of the Burnham Committee. His judicial temper and unfailing courtesy made him an invaluable negotiator.

WE regret to announce the following deaths:

Dr. Charles Chilton, lately professor of biology and Rector of Canterbury College, New Zealand, an authority on the crustacea of New Zealand and the Antarctic regions, on Oct. 25, aged sixty-nine.

Dr. F. W. Dootson, lecturer and demonstrator in chemistry in the University of Cambridge, on Dec. 12.

Admiral of the Fleet Sir Henry Bradwardine Jackson, G.C.B., K.C.V.O., F.R.S., a pioneer in the development of wireless telegraphy, on Dec. 14, aged seventy-four years.

News and Views.

On Dec. 23 occurs the centenary of the birth of the distinguished French chemist Paul Schutzenberger, who was born at Strasbourg in 1829. The son of a professor of law, Schutzenberger took the degree of M.D. at Strasbourg, was for a short time assistant to Persoz (1805–1868), the professor of chemistry in the Paris Conservatoire des Arts et Métiers, and for some years a professor at Mulhausen High School. Returning to Paris in 1865, he became assistant to Balard at the Collége de France, succeeded to Balard's chair in 1876, and from 1882 was also Director of the municipal École de Physique et de Chemie. In 1888 he was elected a member of the Academy of Sciences in the place of Debray, and he died at Mézy, Seine et Oise, on June 26, 1897. The following year his bust was placed in the École de Physique. Schutzenberger paid particular attention to industrial chemistry, especially of colouring matters, and was known for his long researches on the constitution of alkaloids and of the albuminoid bodies. He also prepared a new series of platinum compounds. His works included his book on fermentations (1875) and a treatise on general chemistry in seven volumes. Towards the end of his life he adopted the view that the elements had been formed by some process of condensation from one primordial substance of extremely small atomic weight; and expressed the opinion that atomic weights within narrow limits are variable.

We have received from the Department of Research in Terrestrial Magnetism of the Carnegie Institution of Washington the following statement relating to the loss of the non-magnetic research vessel *Carnegie*, referred to in our issue of Dec. 7, p. 883: "The survey yacht *Carnegie* and her scientific equipment were completely destroyed in the harbour at Apia, Western Samoa, on the afternoon of Nov. 29, 1929, following the explosion of gasoline while it was being stored on the vessel. Capt. James Percy Ault, in command, and one cabin boy were killed, the engineer and mechanic were seriously injured, and three of the sailors hurt. The scientific members of the staff, with the exception of W. C. Parkinson, second in command, are expected with Capt. Ault's body at San Francisco about Dec. 19. Mr. Parkinson is remaining at Apia temporarily, from which place he will proceed later to take charge of the Watheroo Magnetic Observatory in Western Australia. The *Carnegie* was the property of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and had completed about 45,000 nautical miles of her seventh cruise at the time of the accident. Since launching in 1909 she had traversed in all oceans from 80° north to 61° south, a total of nearly 300,000 nautical miles. The data gathered form valuable contributions to the science of geophysics, including terrestrial magnetism and electricity, oceanography, and meteorology."

The new research vessel, the R.R.S. *Discovery II.*, a description of which appeared in our issue of Nov. 23, p. 798, has been loading at St. Katherine's Dock, London, and on Dec. 10 she was inspected by H.R.H. the Duke of Gloucester, who evinced great interest in the vessel and her equipment and made a short speech to the officers and crew. On the following day the Discovery Committee held a reception on board the vessel, and on Dec. 12 she was visited by King Haakon of Norway. The *Discovery II.* sailed on the morning of Dec. 14, and in a month's time will be at work on the whaling grounds of South Georgia.

Last summer, Prof. G. Elliot Smith attended as an official representative of Great Britain the Pan-Pacific Science Congress held in Java, and on Dec. 9 he delivered a public lecture at University College, London, describing his experiences. He said that the recent achievements of the Dutch in Java are worthy of careful consideration by everyone interested in colonial administration, and especially in the application of science for the welfare of mankind. As Mr. Ormsby-Gore, referring to Java, said in his recent report, "It certainly affords the most remarkable example in the world to-day of the application of science to the development of the tropics. . . . The significance of Java has never been fully appreciated in Great Britain or in the other parts of the Empire." In Java scientific research is regarded not as an expensive luxury but as the vital and essential condition of social and economic prosperity, if not of existence itself. Much important work is being accomplished in both pure and applied science, and not only are the results of research being used for administrative purposes, but in addition the spirit of scientific inquiry inspires the attitude of the government. In no department is the effect of this interest more vividly revealed than in the affairs of the people themselves. No visitor to Java can fail to be impressed by the happiness of the teeming multitudes of well-behaved people—the population of Java roughly equals in number the people of Britain. This is in large measure due to the study of the peoples and their customs and beliefs. The understanding of the mentality of the people of Java which has emerged from the interest in and the scientific study of their history and institutions has enabled their rulers to respect the desires of the population and preserve institutions and customs which mean much to them and do not interfere with orderly government.

Apart from these considerations, Java is for the anthropologist a land of intense interest. As the home of the earliest-known member (*Pithecanthropus*) of the human family and of the tree-shrews, tarsiers, lorises, and a variety of monkeys and apes, the Netherlands Indies provide an epitome of man's ancestry. They form the avenue whereby representatives of the most primitive surviving races of men wandered to their homes in Australia and Melanesia respectively. Centuries later, the most adventurous Argonauts of early times made their way through the Archipelago to the scenes of their greatest maritime achievements in Polynesia. Java is the new Atlantis not only in the Baconian sense as the one country where science promises to be the inspiration of

administration, but also in the fact that it is the most important cultural link with the New World. The Malay Archipelago, forming a widely spread group of islands occupying the only means of access to the Pacific Ocean, has throughout the ages acted as a sieve which has retained certain of the elements of the many cultural streams passing from the west out into the great ocean. Repeatedly one sees, not merely on the ancient monuments but also amongst the living population, scores of interesting survivals of the ancient civilisations of China and India, Greece and Mesopotamia, Crete and Egypt, forming an integral part of the modern culture. Inscribed upon the old Indian temples of the eighth and later centuries of the Christian era, there are scores of ornamental designs and other architectural devices the dependence of which upon India and Greece is generally admitted, but which are also assumed by many to be distinctive features of the Maya culture of Central America.

AT a meeting of the Royal Society of Edinburgh on Dec. 2, Prof. V. Gordon Childe read a paper on the early colonisation of northern Scotland as illustrated by the recent discoveries in Orkney. He summarised the variations in climate known to have taken place in Europe since the last Ice Age, pointing out that the most flourishing periods of prehistoric and early historic civilisation in Caithness and Orkney coincided with what should on current climatological notions have been peculiarly unfavourable epochs. On the other hand, historical circumstances lent significance to the position of these lands at the mouth of the North Sea in 'neolithic' times, during the Roman occupation of Britain and in the Viking age. Prof. Childe described the new culture revealed at Skara Brae, Orkney, as the result of divergent specialisation in an isolated area. It was compared in turn with that of each of the periods when Orkney participated actively in the general current of cultural progress. Many features of the architecture of the village can be traced in the 'neolithic' chambered cairns, but the pottery at least is derivable from a definite group found in Scotland during the Bronze Age. The brochs and their culture were examined in great detail, but it is concluded that there are no significant points of contact. The inference is that the village was anterior to the brochs or else represented a renaissance of a purely native culture after the civilisation of the broch builders had fallen into decay. The native culture itself would be derived from the first neolithic colonists coming from the Atlantic, perhaps mixed with Beaker folk from Central Europe. The broch builders represented an entirely new stock, certainly Celtic, but coming immediately from the Western Isles.

IN a Friday evening discourse on Dec. 13 at the Royal Institution by Miss D. A. E. Garrod, on cave excavation in the Near East, it was stated that until the last few years the study of prehistoric remains in Palestine has been practically confined to the collection of material from surface sites. In 1925, Mr. Turville-Petre, excavating on behalf of the British School of Archæology in Jerusalem, discovered a skull of Neandertal type associated with an Upper Mousterian industry in the Mugharet-ez-Zuttiyeh, north of the Sea of Galilee. In 1928 the British School carried out excavations in a cave near Shukba, in the western Judæan hills, where an Upper Mousterian industry resembling that of the Mugharet-ez-Zuttiyeh was found underlying a Mesolithic level, hitherto unknown in Palestine. In the autumn of 1928 a carving on bone, which appeared to be prehistoric, was discovered in a sounding made by the Palestine Department of Antiquities in the Mugharet-el-Nad, at the western foot of Mt. Carmel, and in 1929 this cave was excavated by the British School, in collaboration with the American School of Prehistoric Research. The outer chamber of the cave was much disturbed, but the inner chamber, which was untouched, contained five prehistoric levels, as follows: 1, Mesolithic; 2, 3, 4, Upper Palæolithic; 5, Mousterian. The Mesolithic represents a slightly later stage of the Shukba industry. In the Upper Palæolithic layers northern African and European influences alternate, the industry of 2 being Capsian, while 3 and 4 contain an Aurignacian of European type.

PROF. H. FREUNDLICH, who delivered the second Liversidge lecture before the Chemical Society on Dec. 12, took as the subject of his discourse "Surface Forces and Chemical Equilibrium". Speaking with delightful clarity and fluency, he said that surface reactions are of the greatest importance in technical and biological processes, but that since these reactions are generally very complicated, it is worth while to examine our knowledge concerning the simple case of a chemical equilibrium being influenced by surface forces. Sir J. J. Thomson's treatise on the application of dynamics to physics and chemistry appeared to him to be the true successor of Gibbs' thermodynamical papers, from which the chemist may still derive many suggestions. Prof. Freundlich first referred to the phenomena accompanying the separation of chloroform by the action of alkali on chloral hydrate, and then extended the inquiry to surfaces of solid substances, illustrating quantitative aspects of the adsorption of fatty acids by charcoal and siloscen, and discussing Frumkin's observations on the adsorptive behaviour of charcoal exposed, respectively, to hydrogen or oxygen. When speaking of the work of Deutsch on the colour change of indicators, Prof. Freundlich showed the striking change of colour of an acid solution of malachite green when shaken with an indifferent liquid such as benzene, and demonstrated the production of a deep red colour when a solution of the colourless base of the dye rhodamine O dissolved in benzene is shaken with water.

ADSORPTION of dyes on silver halides was next discussed by Prof. Freundlich, who also described the experiments of Deutsch and Fajans on the formation of a red precipitate at the interface when a solution of sodium eosinate and silver nitrate is shaken with benzene, pentane, or even air, the equilibrium being shifted in the direction of the undissociated and less soluble salt. Undissociated salt is also formed on the surface of the silver halide, and hence the colour change is the same at all interfaces. Other non-reversible reactions at interfaces result in the forma-

tion of an acid soap on the surface of soap solutions, and in the denaturation of proteins when their solutions are shaken with air or other gases. Prof. Freundlich's experiments with Juliusburger on the bromoethylamine—dimethyleneimine transformation in the presence of animal charcoal were illustrated by curves showing the extent of the adsorption of the four substances (the bases and their hydrobromides) concerned in the process, and the effect of the charcoal on the reaction velocities. It was shown that the equilibrium is displaced in such a way as would be expected from Thomson's relation, the formation of capillary active substances being favoured, and that a substance may be more stable at an interface than in homogeneous solution under similar conditions. Concluding with a consideration of the significance of interfaces in biological problems, Prof. Freundlich said: "The fact that substances are formed at interfaces, and are stable there, which are rather rare under the same concentrations without the interfaces may account for the extraordinary structure of many substances which are biologically important. . . . I should not be surprised if the great difficulty which we meet in trying to explain the nature of enzymes is partly due to similar causes. They may be very unstable and active organic substances, perhaps even organic radicals, which are stabilised because they are adsorbed at a suitable interface, but are able to react very energetically in intermediate reactions with other substances also adsorbed on these interfaces."

THE presidential address of Engr. Vice-Admiral Sir Robert Dixon to the Institute of Marine Engineers on Dec. 10 was an authoritative review of the trend of marine engineering during the last few years. As his career as a student began in 1882, and from 1922 to 1928 he was Engineer-in-Chief of the Fleet, Admiral Dixon has been concerned with all the revolutionary changes of the past half-century, while to-day he is actively identified with the development of high pressure steam marine plant. But however much one would like to see steam retain its supremacy the challenge of the oil engine is unmistakable. In the past decade the total tonnage of motor-ships has risen from 700,000 to 6,000,000, and there are ships now running with engines of 20,000 and 25,000 horse-power. It is the high thermal efficiency which has enabled the oil engine to compete successfully with the best steam plant, and if steam is to maintain its position in our mercantile marine the improvements suggested by Admiral Dixon as to mechanical firing, large water-tube boilers, and higher steam pressures are bound to come. There are inherent possibilities in the steam engine cycle which have not even yet been fully explored.

THERE are many factors in the problem of what is the best type of machinery for any particular ship, two of which are weight and fuel consumption. The steam machinery of the *Empress of Canada*, said Admiral Dixon, weighs 380 lb. per s.h.p., while in the *Duchess of Bedford*, built six years later, it was only 282 lb. The corresponding figure for the *Nelson* and *Rodney* was 100 lb., for the *Hood* 81 lb., for the 10,000-ton cruiser 45 lb., and for destroyers, 33 lb. Early Diesel engines weighed 450 lb. per b.h.p., but in a modern liner the weight is only 155 lb., while large submarine engines working on the single-acting four-stroke cycle have been built weighing only 50 lb. per h.p. As regards oil consumption in motor-ships, this runs from 0·4 lb. to 0·44 lb. per horse-power per hour, while in the oil fired steam vessel *Duchess of Bedford* it is 0·57 lb., and this could possibly be reduced with the latest machinery to 0·5 lb. Boiler oil is, of course, cheaper than Diesel oil, and coal is far cheaper than either. The address showed that Admiral Dixon has great faith in the power of our designers to meet the needs of the time, while towards the end of his address he threw out the pregnant suggestion that even the screw propeller as we know it to-day may be superseded, for "the experiments with modern high-speed pumps and hydraulic devices suggest that such a device, comprising possibly a multi-bladed system, is not outside the bounds of possibility".

LAST summer the Institution of Electrical Engineers was specially invited to visit the Pyrenees and inspect the interlinked group of electric generating companies which supply power to the Midi Railway and the chemical and metallurgical factories in the south of France. On Nov. 4 the technical lessons to be learned from this visit were discussed at the Institution. The hydro-electric power developed in south-west France amounts to 340,000 kilowatts, and this is supplemented by 122,000 kilowatts generated by thermal stations. All the generating companies, including the Midi Railway Company, are interconnected electrically. They are controlled by a central organisation. A 'load-dispatcher' located at Tarbes is in telephonic communication with all the stations and works. Arrangements made with the works only allow them to be supplied with current at times convenient to the generating company. By this means the latter can arrange so that it only supplies at practically full load, and so the charge for power is very low. The plants are so designed that they can be put in or taken out of service at short notice. Formerly, for example, calcium carbide furnaces required a fortnight to get into full operation; now they only require about three days. Works which can utilise surplus power during flood seasons get it very cheaply. In the Valleé d'Ossau, every effort is made to utilise all the power available. Three generating stations are installed. The highest station utilises the fall between 6400 feet and 3670 feet. The next uses the fall to 2372 feet; and the lowest, the station at Hourat, uses the fall from the middle station to 1681 feet above sea-level. The change over to electricity does not seem to have benefited the railway much, but it is a national gain to obviate the purchase of foreign coal.

THE Electrical Contractors' Association has done useful work in publishing a little book entitled "Electrical Installation Work." Reasons are first given why architects and the public should take greater interest in the electrical equipment of buildings. The uses of electricity are now so varied that the lighting load taken by a consumer is often only a fraction of his total supply. In addition, the public supply of

electricity is passing through a period of radical change and development. The standard voltage for domestic supply has now been fixed at 230 and low-pressure direct current systems are gradually being converted into alternating current systems at this pressure. The illumination now demanded is often ten times as great as the average illumination ten years ago. An electric fire takes as much current as a hundred of the old 8-candle-power carbon filament lamps and an electric cooker may take as much as 400 of these lamps. Modern electric wiring, therefore, has to be installed with much greater care than the systems used twenty years ago. If it is done by a reputable firm which belongs to the Contractors' Association, the consumer can be reasonably certain that the risk of shock has been reduced to a minimum and that the fire risk is almost negligible. It is advisable that all extensions of the wiring should only be done by competent wiremen. It is a comparatively simple operation to add a few lamps to a circuit, but this must only be done when it is certain that the existing wires can safely carry the existing load. The greatest caution should be used in connecting eliminators and rectifiers for use with radio receiving sets to the house mains. When head phones are used there is a risk of shock. It is best to have the 'all electric' receiving sets installed by an electrical contractor.

THE ordinary signalling systems used on railways suffer from two defects. They depend on the engine driver observing an optical, or acoustic signal, and they depend also on his acting in the way indicated by the signal. The possibility of error by the human element therefore comes in twice. Several systems of signalling have been devised which can, when necessary, automatically bring the train to rest or reduce its speed. The drawback to most of these systems is that they depend on an elaborate network of wires and apparatus on the track, and supervision of them is consequently expensive. A revolutionary system of optical signalling is at present working on several hundreds of miles on the German State railways between Munich and Berlin. An account of this system is given in the *Electrical Times* for Dec. 5. On the front of every locomotive is fitted a powerful lamp which continuously throws a narrow beam of light almost vertically upwards. On the signal posts beside the track a specially designed mirror is fixed which reflects the beam on to a circle of which the middle of the lamp lens is the centre. A number of selenium cells are placed at intervals round the circumference of this circle and for various positions of the mirror different cells are illuminated. Each of these cells gives a different signal to the engine driver. A perforated disc driven by a motor breaks up the light stream into 600 light impulses per second and the apparatus only responds to this interrupted light. This prevents it being actuated by other light sources. The driver's recognition of the signal is not a momentary glimpse. It remains under his observation until either he acts on it or, if he has waited too long, the brakes automatically stop the train.

THAT there is room for an authoritative periodical dealing with metallurgy in all of its rapidly developing phases and forming a link between research and the industry there can be little doubt. Even as an avenue of publication, auxiliary to the journals of the recognised metallurgical societies, there is scope for such a paper. In so far as *Metallurgia*, the first issue of which has just made its appearance, can fulfil these functions, it deserves, and will receive, a whole-hearted welcome. We have in Great Britain nothing of the standing of say *Stahl und Eisen* or the *Revue de Metallurgie*, and the gap in our metallurgical literature is one which should be filled. Among the contents of this first number are Parts I. of articles on refractory materials, the principles and uses of wire ropes, and the heat-treatment of metals by electrical means. Other subjects dealt with include tungsten carbide tools, the Ford foundry at Cork, acid-resisting steels, bearing bronzes, etc. It is clear, therefore, that the producers have in mind the needs of the engineer as well as those of the metallurgist himself. Among forthcoming articles which are announced may be mentioned the discussion of high chromium irons and steels, welding, light alloys, casting methods, etc. The get-up of the paper is excellent, the diagrams and illustrations are both exceedingly well reproduced, and the venture is one which will be watched with the greatest interest and goodwill.

AN essay by Mr. G. G. Coulton entitled "Modern Faith", which deals with "the spiritual problems confronting the younger generation", appears in the December number of the *Realist*. Although fifty years ago doubt about the tenets of the accepted religion often needed a good deal of courage, "at present doubt is unquestionably the line of least resistance for a young man". Yet, though the line of least resistance may be the true line, "the thoughtful mind will be on its guard against it". As Fénelon said, "He who fears excessively to be duped deserves to be duped, and he nearly always does get grossly duped". Mr. Coulton is inclined to take Renan's view that very few people are entitled to criticise Christianity. "No man has a moral or intellectual right to treat Christianity as negligible unless he has attentively faced its history and its present position in society, and found solid reasons for supposing that its past and present hold over men can be explained away." It may be natural, but it is highly regrettable, that the best minds should alienate themselves from the life of religion because of "the crudity and falsehood of certain religious manifestations". A similar policy of abstention from politics is equally disastrous, and is becoming quite as common. We may affect to despise Christianity, yet in it "there is one characteristic which is removed by a whole horizon from vulgarity. It has always been specially rich in that type which we understand under the name of *saint*". These are things which the present generation is too apt to overlook, in natural reaction from the excessive claims, and sometimes the false pleas, of earlier Christian generations. The phenomenon of Christianity, whether as a historical influence in Europe or as a not extinct power to-day, deserves at least as much attention "as we who cannot understand relativity render willingly to Einstein's theory".

THE inadequate harmony between the cultural and scientific points of view is also the theme of Prof. Lancelot Hogben's article in the same issue of the *Realist*, though he treats the subject from a very different aspect. He pleads for "a new humanism which takes as its starting-point the position of man in the physical universe as it is apprehended through the medium of scientific method". He is of the opinion that such a strictly scientific humanism ought to have been the goal of the Renaissance, which somehow got sidetracked into literary and philological studies, neglecting those developments of Greek science which had taken place under Arabian influence during the thirteenth century. The sudden collapse of this Arabian culture certainly presents interesting problems. Renan attributes it to the philosophers having been courtiers, so that when sovereigns became fanatics for Mussulman orthodoxy, the *savants* disappeared and their manuscripts were burnt. It is clear that Prof. Hogben underestimates the difficulties of basing a rich culture purely upon the natural sciences. It is not only that, as Sir James Jeans has recently reminded us, "the ultimate realities of the universe are at present quite beyond the reach of science, and may be—and probably are—for ever beyond the comprehension of the human mind". A yet more fundamental difficulty is that science cannot supply that *qualitative* point of view which is the first condition of any consistent attitude to life. We must have values, but science would cease to be science if it introduced them. Prof. Hogben's hostility to metaphysics has caused him to simplify unduly the problems which he strives to solve. But his plea for the study of the *history* of scientific research, as well as of its methods and results, is one for which we have every sympathy.

THE eighty-sixth meeting of the American Association for the Advancement of Science will take place on Dec. 27–Jan. 2 at Des Moines, Iowa. According to a preliminary programme which has appeared in *Science*, this is only the seventh occasion on which the Association has held its annual meeting west of a line joining Chicago, St. Louis, and New Orleans, and is the first time that it has met at Des Moines. The new president of the Association is Dr. Robert A. Millikan, director of the Norman Bridge Physical Laboratory, California Institute of Technology, Pasadena, and his address will be entitled "The Alleged Sins of Science". The retiring president, Prof. Henry Fairfield Osborn, president of the American Museum of Natural History, New York City, will speak on "The Discovery of Tertiary Man". A general session of the Association will be devoted to the economic aspect of the present status of scientific workers. A general exhibition of apparatus, materials, and books relating to science will be open during the meeting.

AMONG recent appointments in the Colonial agricultural services are the following: Mr. F. W. Hall, plantation manager, Agricultural Department, Uganda, to be assistant director of agriculture, Gambia; Mr. J. R. Mackie, deputy assistant director of agriculture, Nigeria, to be assistant director of agriculture, Nigeria; Mr. R. W. R. Miller, senior agricultural officer, Tanganyika Territory, to be director of science and agriculture, Barbadoes; Mr. W. Cook, to be entomologist, Agricultural Department, Gold Coast; Mr. J. Wright, to be mycologist, Agricultural Department, Gold Coast; Mr. A. B. S. Ransford and Mr. E. W. Gaddum, to be assistant agricultural officers, Kenya; Mr. A. V. Gibberd, to be superintendent, Agricultural Department, Nigeria; Mr. R. J. Sutton, to be produce inspector, Nigeria; Mr. R. H. Fraser, to be agricultural officer, Northern Rhodesia; Mr. H. M. Heald, to be agricultural officer, Department of Agriculture and Forests, Palestine; Mr. B. J. Hartley, Mr. J. Robertson, and Mr. F. R. Sanders, to be district agricultural officers, Tanganyika Territory; Mr. C. W. L. Fishlock, to be agricultural officer, Uganda. Some recent appointments made by the Secretary of State for the Colonies in the forestry services are: Mr. J. R. Ainslie, deputy director of forests, Nigeria, to be director of forests, Nigeria; Mr. N. V. Brasnett, assistant conservator of forests, Kenya, to be conservator of forests, Uganda; Mr. G. W. Chapman, to be assistant conservator of forests, Cyprus; Mr. G. C. Beaven, to be assistant conservator of forests, Gold Coast; Mr. I. D. S. Cameron, Mr. P. C. Lancaster, and Mr. K. R. MacDonald, to be assistant conservators of forests, Nigeria.

MESSRS. Newton and Co., 72 Wigmore Street, London, W.1, have sent us a copy of their catalogue of optical lanterns, epidiascopes, and other projection apparatus. This includes kinematographs, and projection polariscopes and spectroscopes, lamps, resistances, screens, and so on. It is worth while noting that lanterns can be hired, with or without an operator.

THE Annual Report for 1928 of the Rockefeller Foundation by the president, Mr. George E. Vincent, has been published. It records and surveys the world-wide activities of the Foundation in the realm of public health and preventive medicine and in the cause of public health education. The merging of the Rockefeller Foundation and the Laura Spelman Rockefeller Memorial into a new corporation to be known as the Rockefeller Foundation is also reported. The new Foundation's activities will now include not only public health, but also the advancement of knowledge in the medical sciences, in the natural sciences, in the social sciences, and in the humanities.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A pathologist and bacteriologist in the Giza Memorial Laboratory, Cairo—Sir Holburt Waring, 37 Wimpole Street, W.1 (Dec. 30). Clinical assistants (senior and junior) in the Medical, Surgical, and all Special Departments of the Royal Free Hospital—The Secretary, Royal Free Hospital, Gray's Inn Road, W.C.1 (Jan. 4). A principal and professor of medicine at the Veterinary College, Patna—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 15). A senior clinical assistant and clinical tutor at the Royal Infirmary of Edinburgh (Ophthalmic Department) and two clinical assistants—The Superintendent, Royal Infirmary, Edinburgh. Civilian education officers in the R.A.F. Education Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1.

Research Items.

Early Man in India.—In a report by Col. Seymour Sewell and Dr. B. S. Guna (*Memoirs, Archæol. Survey*, No. 35, App. 5), the bones excavated at Nal, in Baluchistan, by Mr. H. Hargreaves of the Archæological Survey and attributed by Sir John Marshall to the chalcholithic age, are described and their possible affinities discussed. Of two crania described by Sir Arthur Keith, one, the 'Sialkot' skull, probably belongs to much the same period as the bones from Nal. These consist of fragments representing thirteen individuals, of whom some were children. With the human remains were bones of birds and mammals, part of a large and remarkable bone pin, and some fragments of pottery. Part of an adult skull was found. The greater part of the left side of the skull is missing, as is the lower jaw. It is markedly dolichocephalic, having the low index of 70. This may be due to a slight posthumous flattening. A crescentic piece of flatly ground limestone was wedged at the back of the hard palate. It is suggested that this is an early form of the Indian custom of placing a gold coin in the mouth and of other methods of occluding the mouth and nostrils to prevent the escape of the soul. The teeth are large and well formed, but very much worn down by a hard diet. The long bones show the flattening usually attributed to life in a mountainous region. Owing to the scarcity of types of this early period, it is difficult to suggest physical affinities. The closest resemblance is to the dolichocephalic type from Kish, except that the Nal skull has a much higher vault. Of the two types found at Mohenjo-Daro, the dolichocephalic also resembles the Kish type, but the brachycephalic appears to be Mongoloid rather than Armenoid, as has been suggested for the Kish brachycephal.

Skull of Ornithorhynchus.—Dr. Kesteven and Mr. Furst (*Jour. Anat.*, vol. 63, pt. 4, pp. 447-472, July 1929) give the first complete description, in the English language, of the skull of the platypus, based on a series of nine skulls, from a fœtal skull measuring 25 mm., to the skull of an old adult. Such a complete series has enabled the authors to work out the development of the skull, and to correlate features of the early skull with those of the adult. They show, among other features, the extent and situation of the presphenoid and ethmoid ossifications, and have discovered that the squamosal bone is excluded from sharing in the formation of the inner wall of the cranial cavity. They believe that an independent lachrymal bone is present as a separate entity in the youngest skull, and is still recognisable up to a skull measuring 65 mm. A discussion on the significance of the alisphenoid lamina of the periotic bone is added by the senior author.

Migration of Sea Animals to Land.—Mr. A. S. Pearse ("Observations on Certain Littoral and Terrestrial Animals at Tortugas, Florida, with special reference to Migrations from Marine to Terrestrial Habits." Papers from the Tortugas Laboratory of Carnegie Institution of Washington, vol. 26, No. 6) makes some interesting experiments and observations on the ability of certain littoral animals to live in fresh water and on land. In their natural surroundings the sea animals of the Dry Tortugas have little or no opportunity to migrate to fresh water, but there are several crabs and hermits which are adapted for living in more or less dry situations. These form a series which inhabit all grades from sea to land, culminating in the land hermit, *Cenobita diogenes*, which lives far from the shore and can do without gills at all, as the author has shown by experiment. Crabs that have migrated landwards show a progressive lessening of gill volume, sometimes developing respiratory tufts on the lining of the branchial cavity. As is stated, "An ideal animal is air-breathing, water conserving, swift, and internally stable". As an example of such an animal that has migrated from the sea, the crab *Ocypode* is instanced, which is swift, aggressive, more or less diurnal, and spends most of its time on land. It is omnivorous and a scavenger, and has lost a third of its gills and developed branchial tufts. An interesting point about this crab is the absence from its gills of parasitic mites which occur on some of the other land crabs. The habit which *Ocypode* has of bathing at intervals in the sea is given as the reason. A separate paper by the author in the same publication (No. 6) describes two of these mites which are new to science.

Experimental Research on Freshwater Plankton.—An important summary of research methods in freshwater plankton laboratories is given in Band 6, 1929, of Dr. August Thienemann's "Die Binnengewasser", which is wholly occupied by Dr. Einar Naumann, Director of the Swedish Limnological Laboratory of Aneboda, in his "Grundlinien der experimentellen Plankton-forschung". The author explains the aims of these laboratories, giving particulars of all researches in every aspect. Throughout, the importance of ecological work is emphasised, and details of methods both in field and laboratory are fully discussed. The laboratory at Aneboda is first briefly described as an example; all terms which have to do with limnological study are defined, and figures of apparatus and tables of reagents for analysis of the plankton, both living and dead, are given. Further sections discuss suitable waters for the laboratory, testing methods, and the regulation of the chemical constituents of water, including the estimation of *p*H, lighting and heating, plankton as food, and the feeding of the plankton organisms; finally, details of plankton culture both in the laboratory and in the open, and problems of plankton research. The cladoceran *Daphnia magna* is very much used in these researches, besides copepods, rotifers, and unicellular organisms, both plant and animal. The whole work is extremely useful to all those who have anything to do with limnological studies.

Japanese Bryozoa.—Mr. Yaichurô, Okada, in his "Report of the Biological Survey of Mutsu Bay, 12. Cheilostomatous Bryozoa of Mutsu Bay" (*Science Reports of the Tôhoku Imperial University*, 4th Series (Biology) Sendai, Japan, vol. 4, No. 1, Fasc. 1, February 1929), continues his survey of the Bryozoa. This is one of the contributions from the marine biological station at Asamushi, Aomori-Ken, and is the second paper on this group by the same author. In the present instalment only the Cheilostomata are described, twenty-seven species in all, six of which are apparently new. These latter include one species of *Ellisina*, two of *Caberea*, one of *Lepralia*, and two of *Micronella*. In *Costazzia costazi* Audouin, which was very common, it was noticed that the zoœcium exhibits a variable outer configuration, forming frequently a cubical mass, infrequently a discoidal convex thickened mass, and occasionally an encrusting mass. So far as these outer characters are concerned they might be regarded as distinct species, but from the characters of the zoœcium they are found to agree and are therefore all included under one species.

Appearance of *Phormia* in *Calliphora* Cultures.—Prof. E. A. Bogdanov (*Nautchno-Agron. Zhurnal*, Moscow, No. 7-8, 1929) records some very interesting observations on the appearance on six separate occasions of the fly *Phormia coerulea* in the pure cultures of the *Calliphora erythrocephala*. The conditions of breeding of the latter (for genetic studies) were such that a contamination of the culture by the eggs of *Phormia* is considered exceedingly improbable. Moreover, the *Phormia* flies obtained in the laboratory differed physiologically from the wild flies of the same species, which could not have happened if they were their direct descendants. The main feature of the laboratory-bred *Phormia* is their inability to propagate further, while the wild fly is extremely prolific; other characters of the laboratory flies indicate also a considerable degree of degeneration, generally in the same direction as in the case of other mutants of *Calliphora*. Very remarkable is the fact that some females of the laboratory *Phormia*, though unable to propagate with their own males, produced fertile progeny with the males of *Calliphora*, and the hybrids of the first generation were indistinguishable from the normal *Calliphora*; thus the laboratory *Phormia* proved to be completely recessive to *Calliphora*. This can only occur in a case of a true mutation. In the following generations there was no uniformity, and most of the flies were pathological, but clearly belonging to *Calliphora*; in one case, however, a *Phormia* was obtained in the second generation. The author does not insist that the transmutation of one genus into another has actually taken place and is prepared for some other explanation. His main object in publishing the observations is to attract the attention of other workers on *Calliphora*, since it is probable that when similar cases are observed, they are attributed to an accidental contamination and not investigated in detail.

Newer Tertiary Fossils from the Dutch East Indies.—Collections of Newer Tertiary fossils from the Dutch East Indies are described by F. Siemon (*Ber. Naturf. Gesell. Freiburg i. Br.*, Bd. 29). One series was obtained on two expeditions, in 1907 and 1909–10, from the south-west of Dutch New Guinea in the regions drained by the North River, the Bibis River, and the North-west River. Twenty-two species of mollusca, two being new, with a few corals and foraminifera, as well as a selachian (*Carcharias gangeticus*, Müll.) are recorded and tabulated from Miocene and Pliocene deposits. Two text maps and half-tone figures from photographs of the new species accompany this part. Another series of fossils was collected by Prof. G. G. L. Kimmerling in the neighbourhood of Cheribon in Java, and these are dealt with station by station. In age they range from the Eocene upwards.

Observing Sea Temperature.—In discussing the reliability of various methods of taking the surface temperature of the sea (*Journal of Washington Academy of Sciences*, vol. 18, No. 20), Mr. E. F. Brooks notes that, with all its faults, the bucket method affords the only practical method for general use. It is useful, therefore, to note some of the sources of error that are likely to occur. The first source of error is that the bucket is unlikely to have the same initial temperature as the water: this may mean an error of 0·1° C. Then, again, the water sample may be cooled by evaporation and conduction. The conduction cooling can be prevented by a rubber covering two to four millimetres in thickness. Evaporation is less easy to check and may account for a fall in temperature of 0·5° C. The thermometer generally used has a metal case which may have an appreciable effect, but the case can be removed and this error thus obviated. A quick responding thermometer is advisable to prevent the likelihood of a false reading, and for the same reason the thermometer should be read while in the water. A few other minor sources of error are noted. Mr. Brooks also shows that experiments have proved that in calm weather the temperatures at the surface and at a depth of 5-8 metres vary within 1·5° C. In rough water, however, there is little difference, and a thermograph attached to the condenser intake should give reliable surface temperatures.

Afforestation and Stabilisation in Granada.—The publication of the *Instituto Nacional de Investigaciones y Esperiencias Agronómicas y Forestales* (Año 2, Núm. 3, Madrid, 1929) contains several articles of interest. To a country possessing so little forest as is the case in Spain, one of the most important is a project for the correction and stabilisation of certain tracts of land in the Province of Granada, by J. M. Garcia Nájera, a mountain engineer. The author, after briefly discussing points justifying the scheme, proceeds to describe the geology of the area and the causes of instability. The primary cause, probably dating back several centuries, was the ruthless disafforestation practised, accompanied by and completed by fire and the pasturage of animals—especially goats. The engineer of course regards the matter from the point of view of the conditions actually existing, and they demonstrate the necessity of governments considering this question of erosion and denudation in mountain regions due to the absence of protection by existing forests. For present neglect will not only prove directly injurious to the descendants of the existing populations practising wasteful methods of utilisation, but will also result in heavy expenditure, which Spain is now undertaking in the stabilising work herein dealt with. The author discusses the various possible means for dealing with the instability and his proposed solution. This involves the construction of a main dyke, channels for intercepting water, embankments and trenching work and general drainage schemes. Lastly, plans of afforestation are dealt with and the establishment of rain gauges on the area. The article is illustrated with some excellent photographs and several plans depicting the works to be undertaken.

Repulsion of Atomic Kernels.—In the November number of the *Journal of the American Chemical Society*, W. M. Latimer has considered organic rearrangements from the point of view of the change in the repulsion of the atomic kernels which results from the chemical change and has arrived at the following conclusions. The great majority of rearrangements take place with a decrease in the inter-kernel repulsion energy; a few occur with no change in repulsion energy and are then regarded as resulting from a state of high activation of the molecule, and the product is a mixture of the two forms. Rearrangements with an increase in repulsion energy are rare and invariably accompanied by complex redistributions of electrons in the molecule. The observations are in accordance with the following premise: if there are several possible arrangements of the atoms in a molecule which have the same number of electrons per atom and satisfy equally well the tendencies of the more electro-negative elements to complete their octets of electrons, that form will be the most stable which gives a minimum of repulsion between the atomic kernels.

Permeameters, Rods and Strips.—The general principles of permeameters for testing rods and strips of iron by the use of a yoke to provide a return path for the magnetic flux are well known. The main diffi-

culty of such apparatus is to approximate sufficiently closely to the condition of uniform magnetisation which is assumed in the formulæ. To effect this, various means for compensating for lack of uniformity have been devised. With a uniform specimen, complete uniformity of magnetisation involves equality of magnetic potential and absence of magnetic leakage. The Iliovici permeameter tests the first condition and the modified form of Picou permeameter the second. In the November issue of the *Journal of the Institution of Electrical Engineers*, C. E. Webb and L. H. Ford describe precision permeability measurements on straight bars and strips in the region of high permeability. The construction of a yoke apparatus to give magnetising forces up to $H = 3000$ on straight samples 25 cm. long and up to $H = 5000$ on straight samples 10 cm. long is described. Search coils are used to measure the magnetising force and the conditions for satisfactory compensation for leakage are determined. It was found that solid bars were less liable to the effects of stress than sheet samples, but slightly bent or twisted specimens clamped between flat blocks give rise to serious errors. When search coils are wound directly on the sample, sheet material rings are very liable to be stressed. The errors due to variation in the reluctance of the path of the magnetic flux can be avoided by limiting the number of strips in the sample to ten, provided that they be accurately cut to a uniform width. For values of H greater than 15, the effects of stress and variation of reluctance become negligible.

Reactions of Atomic Hydrogen.—The action of atomic hydrogen prepared by Wood's method on a number of organic compounds has been studied by Urey and Lavin, whose results are published in the November number of the *Journal of the American Chemical Society*. Atomic hydrogen is, on the whole, a rather mild reducing agent. It reduces azoxybenzene at least partly to azobenzene and azobenzene partly to hydrazobenzene, with aniline as a final product. Certain solid dyes are reduced to colourless compounds which are partly oxidised again to the coloured form on exposure to air. Benzoic acid and acetamide catalyse the recombination but are not noticeably reduced. Atomic hydrogen recombines in the presence of formic acid. A small amount of formaldehyde is produced, probably due to the decomposition of the acid by heat into water and carbon monoxide and the subsequent formation of the aldehyde from carbon monoxide and atomic hydrogen. Acetaldehyde is polymerised to paraldehyde.

Vapour Pressure of Rubber Jellies.—In the October number of the *Journal of the Chemical Society*, P. Stamberger describes experiments on the vapour pressures of rubber jellies in three solvents; benzene, chloroform, and carbon disulphide. Up to a certain concentration the rubber causes no appreciable vapour pressure lowering, but beyond this the lowering increases rapidly with concentration. This result is quite different from that with 'true solutions' (molecular dispersions), for which a linear relation with concentration holds up to high concentrations. The results with different samples of rubber agreed, thus suggesting that rubber is probably a definite hydrocarbon and not a mixture of hydrocarbons of different degrees of polymerisation. The results are interpreted on the lines of the formation of solvated layers and not swelling by capillary forces. During the first stage of the process it is assumed a layer of solvent molecules is formed around the rubber particle, leaving free solvent to exert the normal vapour pressure. In the solvated layer solvent molecules exhibit vapour pressure lowering. The results are shown to favour the assumption that the rubber molecules are long chains, and this type of molecule seems to be characteristic of substances which show swelling.

Liquid Crystals and Chemical Constitution.—The property possessed by certain chemical compounds of forming liquid crystals has been studied by D. Vorländer, who attempts in two papers in the November issue of the *Berichte der Deutschen Chemischen Gesellschaft* to correlate this property with certain deductions as to the relative orientations of two or more long chains of atoms to one another. It is shown that the non-appearance of liquid crystals in such derivatives of urea and thio-urea as are obtained by introducing two *p*-amino-*p'*-ethoxyazobenzene groupings into the molecule may be due to the angular divergence of these two long groups, which are linked together by the carbonyl or thiocarbonyl group at an angle of 109°. When, however, these compounds are converted to the corresponding di-imide by removing water (or hydrogen sulphide), this divergence disappears, since the double linking of each nitrogen atom to the central carbon atom results in a linear configuration –N=C=N– and the compound can exist in the liquid crystalline condition. This evidence is confirmed from a study of the esters which trimesic acid and the three phthalic acids produce with such lengthy chain compounds as *p*-phenetoleazophenol. The star-shaped orientation of the trimesic esters and the angular divergence (60°) of the chains in the ortho-esters seem to preclude the possibility of liquid crystal formation. The meta-esters with a divergence of 120° melt to liquid crystals which persist only over a short temperature-range, whilst the para-esters, in which the two chains are said to lie in a straight line, are described as supra-crystalline, that is to say, the liquid crystalline condition is so stable that the amorphous liquid state is not even attained.

Voltage Control of Large Alternators.—One of the difficulties which electrical engineers have to overcome is to maintain the voltage constant at an alternator's terminals when large loads are suddenly thrown on or off. An alternator requires direct current excitation, and its voltage is regulated by varying the current given by a direct current machine. The magnetic circuit of the alternator does not respond instantaneously to a change in the exciting current. The magnetic circuits of large machines store a large amount of energy, and consequently there may be a lag of a second or two in responding to the changes of the exciting current made necessary by sudden changes in the load. H. W. Taylor discussed the voltage control of large alternators in a paper read to the Institution of Electrical Engineers on Nov. 28. Voltage control is now required to be automatic within one or two per cent of its normal value. The author discussed the action and reaction of the two machines. In certain cases the alternator voltage is unstable, as, for example, when the load consists of a large overhead network on a light load or unloaded underground cables. In these cases the voltage can rise to a high value. Methods are given in the paper for computing the curve of falling voltage when a sudden load is thrown on the circuit. Modern voltage regulators act only on the field circuit of the exciting dynamo. The alternators have such large exciting currents that it would be impracticable to operate the very heavy contact pieces that would be required to vary their magnitude. An interesting oscillograph record is given of the transient variation in the field current when a change in the nature of the load changes the magnetic flux of the machine.

British Museum Expedition to British Honduras.[1]

By T. A. JOYCE.

THE objective of the British Museum Expedition to British Honduras this season was the group of ruins situated between the Pusilha and Joventud branches of the Mojo River in British Honduras. A preliminary investigation of the area had been made in 1928 by Capt. E. L. Gruning, Dr. T. Gann, and Mr. H. Clive-Smith. The primary objects this year were to bring back as many as possible of the inscribed stone stelæ; to excavate a cave which gave indications of having been used as a pottery dump; to survey the main site so far as possible; to carry on excavation in the numerous mounds; and to prospect for other ruins in the neighbourhood. I was accompanied by Capt. E. L. Gruning, who undertook supervision of transport; and by Mr. Robert Ashton, who looked after the commissariat.

The expedition sailed on Jan. 31, and reached Punta Gorda, the jumping-off place, on Feb. 23, leaving for Pusilha on Mar. 4.

The cave appears to be a natural cavity in a limestone outcrop of some size, on the summit of which were a series of low mounds. Some of these mounds were excavated, but yielded no results beyond fragments of coarse domestic pottery, and the natural inference is that they were hut foundations. Entrance to the cave was made laterally from the lower level, but the opening here may be of comparatively late date, and produced by the fall of a large tree tearing away the side of the cavern. A kind of 'chimney' leads from the cave to the surface of the outcrop. It seems probable that this chimney was the original means of access to the cave, and that the ancient inhabitants of the village erected on the summit of this outcrop used this 'oubliette' as a convenient dump for broken and discarded pots. Yet it is quite possible that the cave was also, in a sense, a sacred place, because traces of five burials were found there. However, these burials may be intrusive.

The cave measures some 33 feet in length, and at its widest transverse diameter, 12 feet. Excavation carried down to the rock floor showed that the deposit measured some 10 feet in depth. The contents of at least one-half of the cave were removed in layers of approximately 1 ft. 6 in. to 2 ft. in depth. The soil in the cave was heavy and sticky from the surface to a depth of about 3 feet. Below that it was fairly crumbly, and easier to work and search.

When half the cave had been partially excavated to the depth of about 7 feet, it became apparent that the archæological strata were not horizontal but curvilinear, the richest finds appearing immediately under the chimney. It is evident, therefore, that the greater part of the remains had been thrown down the chimney, forming a mound.

The results may be summarised as follows: The main bulk of the remains discovered consisted of pottery fragments of great variety. The greater portion consisted, naturally, of coarse domestic ware, so-called 'ollas' and dishes. But there was an unusually high percentage of bowls and tripod plates painted in slip, and frequently bearing hieroglyphic inscriptions. The quality of paste is extremely variable, ranging from a rather thick and friable ware to a very thin, hard, and perfectly fired pottery. The slip decoration comprises two or three shades of red, yellow, orange, and black. Most of the designs are outlined in the last.

Occasionally a peculiar grey colour is incorporated in the design, a grey which verges on blue, especially when it is combined with one of the more brilliant reds. Certain fragments, few in number, show the remains of a thick turquoise-blue slip, rather coarse in quality, which was evidently applied to a completed pot and subjected to a secondary firing. This slip, which bears a remarkably close resemblance to the blue slip characteristic of Mexican Toltec ware, is for the most part imperfectly fired, and only survives in patches. This secondary slip, in a colour (and material) which has usually been associated with the Toltec period of Mexico, appears only in the lower strata of this cave, and seems to have been more or less experimental. There can be no question that the pottery of this cave antedates the Toltec period by centuries, and there is not the slightest indication of Mexican influence throughout the complex.

A chocolate-coloured ware, deepening to black, with impressed or incised ornament, thin walls and well fired, appears in small quantities in most of the layers. Incised and 'fluted' ware came from the lower strata. Engraved pottery (on which designs had been carved after firing, or at least sun-drying), also belonged to the lower strata.

The depth of the deposit provided six strata, of 1 ft. 6 in. to 2 ft. each, and these were numbered from 1 to 6 in a downward direction. By far the richest stratum was the fourth, in which examples of practically every style were found. The top stratum, consisting in the main of comparatively recent vegetable humus, was poor in remains apart from coarse domestic pottery. The remains characteristic of the deepest three strata include bowls of rather thick ware, painted with designs in black on yellow. So far as my knowledge goes, this ware has not been found at any other site. Here, too, were found fragments of polychrome ware, many of them well fired, ornamented with series of stepped coils or frets, a design which appears to have gone out of fashion in later times. The same statement is true of the fluted ware. The use of the peculiar grey slip, mentioned above, appears to start in the fourth stratum and continue until the second, while the turquoise-blue slip, probably involving a second firing, belongs to the fourth and fifth. The incised ware, though comparatively scanty, belongs to the third, fourth, and fifth strata, but the rare engraved fragments only to the fourth and fifth.

Decorative motives derived from the vegetable world have hitherto been regarded as very rare in Maya art; but the Pusilha potters made great use of a design resembling a twisted liana with dependent buds. This design, which lasted from the fifth to the second stratum, is particularly characteristic of the site and is more frequently met than any other. Another 'vegetable' design, of flower-petals, is also found in the second, third, and fourth strata.

Associated with these upper strata (second to fourth) is a very interesting class of ware in which the designs, usually formal, are painted in a singularly brilliant red on a buff ground. Some of this ware is magnificent from a technical point of view. In many cases the paste is marvellously thin and light, perfectly fired; and the slip-decoration is so highly burnished that it gives the illusion of a glazed surface. The rare pale grey slip appears on vessels of this class, emphasising details; and some of the vases show a stippled ornament in red, which must have been applied by means of a stiff-bristled brush or its equivalent.

As regards the animal world, figures of monkeys are shown on fragments from the fourth and fifth

[1] From a paper read at a special meeting of the Royal Anthropological Institute on Dec. 10.

strata, and also birds. The finest piece of painting was a single fragment, which in style recalls the art of Palenque, discovered in the sixth stratum. A number of tiny bowls, of very rough ware, often in the form of birds or animals, were found in the middle strata. These may have been votive offerings, or, more probably, children's toys.

As regards the plates, tripod and plain (with a simple ring foot), the ware is thicker and coarser than that of the bowls, and the feet, where present, are of the cascabel pattern, hollow, and enclosing a small clay pellet which forms a rattle. The rims are usually surrounded with a band of painted design, based on textile art, or the 'twist-and-bud' pattern, often supplemented with a row of glyphs. The centre is usually occupied by a formal design (often cruciform), but sometimes by the figure of an animal or snake or human being.

Apart from fragments of *metates* and *manos* (the tripod slabs and rollers used in grinding maize), stone remains were remarkably few, and represented by only three spear-blades of flaked chert. Obsidian flakes and cores were found in quantities.

A remarkable bone pendant was discovered in the second stratum. This is formed from the ascending ramus of the right mandible of a human lower jaw. The condyles have been filed off, and just below the notch a hole has been pierced for suspension. The exterior surface is covered with relief carving, the main feature of which is four glyphs arranged in a square. This object, which is probably an amulet, is, I believe, unique.

Objects of worked shell are rare, and limited to a few beads. The most interesting is a large spiral shell, which had been rubbed down on two sides, so that the remaining portion represents the central longitudinal section. Small river-shells, some pierced for suspension, were found in quantities.

New Sundial in the Royal Botanic Gardens, Kew.

SOME months ago a beautiful pillar which had come from the old Kew Bridge, and had been presented to the Royal Gardens by Mr. George Hubbard, was set up in the grounds of Cambridge Cottage. Prof. Vernon Boys, having learned from

FIG. 1.—New sundial in the Royal Botanic Gardens, Kew.

the Director that a sundial was required to stand on this pillar, generously offered to provide one which would be worthy of the position. Prof. Boys has designed a dial and made it himself. It is now in place and can be seen and proved by the public (Fig. 1).

Nowadays a sundial is generally regarded as a mere ornament to a garden, and if it is in error by a few minutes nobody minds. After all, the dial gives local apparent time and it is too much trouble for most people to ascertain the correction necessary to obtain Greenwich mean time. Prof. Boys has no patience with such slackness. He has aimed at getting the time to the nearest minute. Not only is his dial made with the greatest precision; it carries an inscription on the southern or upper cube which

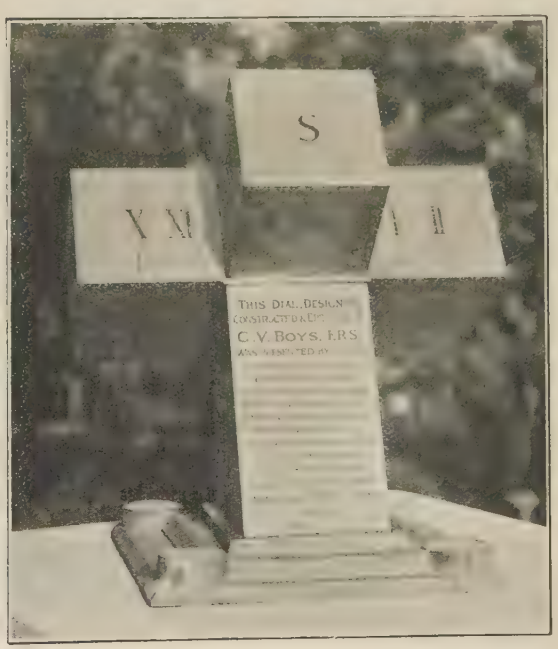

FIG. 2.—'Dial' of the Kew sundial.

gives in clear figures the correction to be applied to deduce Greenwich mean time from Kew apparent time on any given day of the year. This is contained in a table of 88 entries calculated from the equation of time of next year (a year half-way between two leap years), for each day, to which the time corresponding to the longitude of Kew has been (algebraically) added. Any member of the public by adding the correction of the actual day to the time shown by the sun, or subtracting as the case may be, will have Greenwich mean time.

The dial itself is not of the conventional type (Fig. 2). In fact it is doubtful whether the word 'dial' is strictly appropriate. Perhaps we should say that there are six dials. Prof. Boys had adapted a design which is to be found occasionally in churchyards. The dial is built up with five blocks arranged in the form of a Greek cross. When the dial is in position the plane of the cross is parallel to the equator, so that the outer edges of the cubes which form the arms are parallel to the earth's axis. The shadows of these outer edges fall in succession on the adjacent arms of the cross. The graduations which serve for telling the time are along the edges. Gun-metal has been used for the cross and its stand. The central block is a cube; the other four blocks which form the arms of the cross are 3 in. long and $2\frac{7}{8}$ in. wide. The accurate machining of these blocks is a necessity of the design.

The engraving was done for Prof. Boys by Mr. H. Routledge, who is the engraver responsible for the finest work on Admiralty charts. After the divisions and lettering had been engraved, each part of the dial was exposed to very dilute hydrogen sulphide and ammonia for about two minutes. The black was cleaned off the flat surfaces with Water-of-Ayr stone and the engraved work was left black. The effect is very pleasing.

The five blocks which form the dial are mounted on a trapezium-shaped support at the inclination appropriate for Kew. How the parts are held together is not apparent. The support is attached to the stone pedestal in a neat way. Four bolts are cemented into the pedestal. After the nuts were screwed on to these bolts, melted tin was poured into little pits surrounding the nuts and hides them from sight. No one will be tempted to unscrew the bolts and appropriate the sundial.

The precision with which a sundial can be used is limited by the lack of sharpness in the shadow of the gnomon. Theoretically, the width of the penumbra should be equivalent to two minutes on the time scale. It is found that time can be read to a minute on the new dial. Probably the reading corresponds fairly closely with the middle of the penumbra and is therefore in accordance with the intention of the designer. By a curious chance the sundial has been placed in the only part of the Royal Gardens from which a public clock is clearly visible. The clock of Kew Church can be seen over the wall of the Gardens and it will be possible to regulate the clock by direct comparisons with the dial.

It will be seen from Fig. 1 that the dial is well balanced on its pillar and looks handsome as well as businesslike.

The history of the dial and the stone column which supports it is engraved on the sloping face of the trapezium-shaped support and is as follows:

"This Dial, Designed, Constructed & Erected by C. V. Boys, F.R.S., was presented by him to The Royal Botanic Gardens, Kew. Engraved by H. Routledge. The Stone Column taken from Old Kew Bridge was presented by George Hubbard, F.S.A., the capital and base were supplied by H.M. Office of Works. A. W. Hill, F.R.S., Director. 1929."

Visitors to the Gardens who are interested in sundials should remember to look at the dial which was put up by William IV. to commemorate Bradley's observations at Kew House. The pedestal of this sundial bears the King's monogram very skilfully carved. The dial itself was made by Tompion.

Filterable Viruses.[1]

THE invisible multiplying bodies generally known as filterable viruses are among the most interesting things in biology to-day, partly because they are the cause of many diseases in animals and plants, and chiefly because they seem as if they might in the end prove to be some of the transitional forms between live and dead matter. Knowledge about them is moving so quickly that it is difficult to know at any moment where we are, and the compilation which Dr. E. B. McKinley has put together will be welcomed as a useful attempt to summarise all we know of them up to date.

Dr. McKinley deals rather fully with the virus diseases of man, animals, fowls, fishes, and insects—about fifty in number—and has a chapter on typhus and the other *Rickettsia* diseases, in which the organisms are just visible. Under each disease he gives an adequate summary of the behaviour of the virus, and, going through them, one cannot but feel that we have to do with what is really a natural group of agencies, though they are distinguished from better known agencies, such as bacteria, mainly on the point of size.

These summaries necessarily contain only a selection of what has been said about each virus, and the selection of the compiler is naturally influenced by his point of view. Dr. McKinley writes mostly as a systematist and he nowhere notices Sanfelice's work on epitheliana contagiosum of fowls, his separation of a nuclo-proteid which would reproduce the disease on inoculation into a fresh animal and his fundamental suggestion that a virus might be a chemical substance which influenced cells in such a way that they produced more of it.

The account of the virus diseases of plants is far less satisfactory: it is not clear whether the author meant it to be as complete as that of the animal diseases or not: it certainly is not. This is rather unfortunate, for plants show clearly some important points which are not so plain in animals, as, for example, the possibility of a host containing large quantities of virus without showing any symptoms of disease, as potatoes often do. The modes of transmission in the plant diseases are also curious, for while some of them, for example, tomato mosaic, are easily conveyed by contact or inoculation, others, such as aster yellows, can be passed from one plant to another only by insects and artificial inoculation fails. The animal diseases such as yellow fever, which are normally conveyed by insects, can be transmitted equally well by a hypodermic syringe. It seems as likely that we shall get a just view of what viruses really are from a study of those of plants as from those which affect animals: the Rous cancer virus and the bacteriophage are also very significant: both of them are dealt with by McKinley.

Another section discusses the vexed question of invisible forms of ordinary bacteria, for which there is a good deal of evidence not to be lightly dismissed, and finally the strange 'inclusion bodies' are described and abundantly illustrated. These large intracellular, often intranuclear, objects are present in many, though not all, of the animal and plant diseases, and they have a characteristic appearance which may be put to useful purposes in diagnosis, for example in rabies. They may represent some form or stage of the virus itself, but they are more probably peculiar cell-reactions: their specificity recalls that of plant-galls, and contrasts strongly with the relative uniformity of the tissue reactions of animals to different bacillary parasites.

[1] "Filterable Viruses and Rickettsia Diseases." By E. B. McKinley. *Philippine Journal of Science*, vol. 39, pp. 1-416, 70 plates; 1929.

Radio Communication in the British Navy.

THE history of the development of radio communication in the British Navy is of great interest. From a paper on "Naval Wireless Telegraph Communications", by G. Shearing and Captain Dorling, which was read to the Institution of Electrical Engineers on Dec. 4, we learn that Admiral Jackson experimented with radio waves so far back as 1896. In 1899, with the help of Marchese Marconi, ranges up to 50 miles were obtained. In 1909 a crystal detector was first used, and in 1914, immediately prior to the War, valve reception was passing out of the experimental stage. During the War, arc and spark systems were generally used, but the thermionic valve system soon made them obsolete. The six months' cruise of H.M.S. *Renown* in 1927 provided opportunities for testing the capabilities of short-wave working on long ranges. With the exception of three days, communication was easily maintained with Whitehall.

The British Navy is divided up into squadrons, which are normally situated in distant seas under the orders of a Commander-in-Chief. There are squadrons, for example, in China, the East Indies, Africa, America, and the West Indies. Each naval area has one or more land radio stations which act as terminal points for the traffic to and from the Admiralty and as distributing and collecting centres for ships in the vicinity. If no commercial stations are available the naval stations are also used for communicating with merchantmen. They have a range varying from 1000 to 2000 miles and can also be linked up with the cable and land-line systems. The advent of the short-wave system has now made it possible for ships in any part of the world to communicate directly with each other and with the Admiralty at certain times of the day.

To obtain the results given above, H.M. ships of the cruiser class are fitted with a 12-kilowatt transmitter for long waves and an 8-kilowatt transmitter for short waves. Valve transmitters are always used. The long-wave apparatus has a range of about 1500 miles. In addition, they have two or three sets of receiving apparatus for long and short waves, besides direction-finding sets and fire-control radio sets. All the standard apparatus used is robust and simple to handle. It is proof against vibration and shocks from gunfire and has to be trustworthy under all climatic conditions. In the battle fleet, the commander must be able to transmit his orders to any unit of the force and be in touch with the Admiralty at the same time.

The striking feature of a modern fleet action is the speed at which everything happens. If the two fleets are approaching one another at a speed of between 40 and 50 miles an hour, then even with aircraft reconnaissance the time between first sighting the enemy and joining action may be only about an hour. The valve transmitters used after the War generally used frequencies between 60 and 3000 kilocycles, that is, wave-lengths between 5000 metres and 100 metres. The introduction of short waves, however, has modified the requirements very considerably. Their advantages for long range working at distances from a few hundred miles up to world-wide range during certain hours of the day are well known. It has been necessary, therefore, to arrange for the fitting of attachments to the existing sets capable of transmitting on a band of waves from 4300 to 21,500 kilocycles in breadth (wave-lengths of 70 metres to 14 metres).

Antarctic Meteorology.

AFTER considerable delay, due principally to lack of funds, it was found possible in 1923 to undertake the tabulation and reduction of the several series of meteorological observations taken by the Australasian Antarctic Expedition of 1911–14. The first two (Series B, Vols. 3 and 4) of four contemplated volumes are now published.[1] Another volume is to deal with the records taken during a winter at Queen Mary Land and the observations made on the aurora during the antarctic and sub-antarctic courses, and the last will contain a discussion of the figures.

The Macquarie Island station functioned after the return of Sir Douglas Mawson's Expedition, but owing to War conditions was closed down in December 1915. It has not since been found possible to reopen it. The monotony of the climate does not suggest that very important data would be obtained from its continuance, however valuable it might be in forecasting. Temperature ranged within a few degrees of 40° F.; precipitation occurs on most days in the year and strong westerly or north-westerly winds prevail. The rainfall records are not so complete as the other data, which are very full.

Vol. 4 covers a period of 22½ months at Cape Denison on Commonwealth Bay, the headquarters of the expedition. These data are most important in their contribution to the study of the antarctic climate and particularly to the well-known antarctic blizzards. Sir Douglas Mawson chose a thoroughly uncomfortable but most valuable site for his station. He arranged for all observations to be taken every six hours, except during the latter part of the second year, when the screen thermometer was read only once a day. In addition to the detailed tables, the meteorological journal of the expedition is printed.

Mr. Madigan rightly says that the wind is the outstanding characteristic of Adélie Land. So far as records go, Commonwealth Bay would appear to be the windiest place on earth. The mean hourly wind velocity for the whole period of 22 months was 44·2 miles per hour. It may be recalled that 43 miles per hour is a gale on the Beaufort scale. In February 1912, which was the calmest month, the average velocity was 26·2 miles per hour. Wind velocities were taken with a Robinson cup anemometer, except for short periods when they were visual owing to the instrument being damaged by the wind.

The wind blew mainly from the south-south-east and south and was generally very steady, so that after some practice the explorers abandoned crawling and walked on their feet in 90-mile currents of air, leaning on the wind. There were occasional periods of calm and variable winds, but these were apparently local, for the wind could frequently be heard roaring on the plateau to the south, and to the west of the station drift snow could be seen sweeping down to the sea. Local whirlwinds from the north sometimes interrupted the short calms.

Mr. Madigan does not discuss the antarctic atmosphere circulation, but we hope he will do so in the final volume of the series.

[1] Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series B, Vol. 3: Meteorology. Tabulated and Reduced Records of the Macquarie Island Station. Recorders: G. F. Ainsworth, H. Power and A. C. Tulloch. Reduction and Tabulation of Data, by Direction of H. A. Hunt, and under Superintendence of B. W. Newman. Pp. 544+4 plates. 40*s*. Vol. 4: Meteorology. Tabulated and Reduced Records of the Cape Denison Station, Adélie Land. By C. T. Madigan; with an Appendix by W. E. Bassett. Pp. 286+viii+2 plates. 30*s*. (Sydney: Alfred James Kent, 1929.)

University and Educational Intelligence.

BIRMINGHAM.—At a degree congregation held on Dec. 13, the degree of M.D. was conferred on John William Field for a thesis entitled, "A Study of the Dietary of the Tamil Cooly of the British Malaya, with special reference to the influence of Vitamin A, Starvation of Physique, and Resistance to Disease"; and on Cyril John Polson for a thesis on "Observations upon the Metabolism of Iron in the Animal Body". The degree of D.Sc. has been awarded to Francis Eric Keep for a thesis on "The Geology of the Shabani Mineral Belt, Belingwe District", and other reports of the Southern Rhodesia Geological Survey.

BRISTOL.—On Dec. 13, Mr. Winston Churchill was installed as Chancellor of the University. After the ceremony, the honorary degree of LL.D. was conferred, among others, on Mr. Churchill and on Dr. T. F. Sibly, vice-chancellor of the University of Reading.

CAMBRIDGE.—A meeting of the electors to the Drapers professorship of agriculture will be held on Friday, Jan. 17. It is proposed that the stipend of the professor shall be £1200 a year in addition to £200 as head of the Department. The administrative duties of the professor include co-operation with the Ministry of Agriculture and Fisheries, which gives financial support to the School of Agriculture and maintains a number of agricultural research institutes closely associated with it. Candidates should communicate with the Vice-Chancellor on or before Tuesday, Jan. 7.

The Director of the Solar Physics Observatory has appointed Mr. C. P. Butler to be first senior observer and Mr. W. Moss to be second senior observer.

Mr. W. B. R. King, Magdalene, has been reappointed assistant to the Woodwardian professor of geology.

Mr. L. C. G. Clarke, curator of the Museum of Archæology and Ethnology, has been elected to a non-stipendiary fellowship at Trinity Hall.

GLASGOW.—The chair of geology in the University, recently vacated by Prof. J. W. Gregory, has now been filled by the appointment of Mr. E. B. Bailey, of H.M. Geological Survey. Prof. Bailey is one of the most distinguished of Scottish geologists. He has played an important part in the work of the Geological Survey during recent years and is particularly well known for his studies on Carboniferous igneous rocks and his unravelling of the complicated geological structure of certain parts of the Western Highlands—notably the Island of Mull and the Ben Nevis–Glencoe district. In the period of the War, Prof. Bailey also played his part, and was awarded the Military Cross, the Légion d'Honneur, and the Croix de Guerre with Palm.

ACCORDING to the twelfth report of the Technical Optics Committee of the Imperial College of Science and Technology and the Advisory Council in Technical Optics to the London County Council, for the year ending July 31, 1929, the teaching at the Imperial College and at the Northampton Polytechnic has be co-ordinated by the adoption of the same symbols, and it is proposed to provide at the latter a two-year day course in addition to the one-year course provided hitherto. At the Imperial College ultra-violet microscopy is to be developed for regular users of the microscope and research work on colour vision, resolving powers of objectives, and the ruling of gratings is to be continued. Prof. A. O. Rankine has been appointed Director of the Department. The number of students is about 20, and the annual cost about £5000.

Calendar of Patent Records.

December 22, 1818.—The hobby-horse, the forerunner of the bicycle, was the invention of Baron von Drais, and was introduced into England by Denis Johnson, coachbuilder, of Long Acre, who was granted a patent for it on Dec. 22, 1818, under the title of "a machine for the purpose of diminishing the labour and fatigue of persons in walking and enabling them at the same time to use greater speed, which said machine he intends calling 'the pedestrian curricle'". One of his machines, built for a Duke of Marlborough, is now in the Science Museum.

December 23, 1801.—The jacquard loom takes its name from Joseph Marie Jacquard of Lyons, who was granted a patent in France on Dec. 23, 1801, "pour une machine destinée à suppléer le tireur de lacs dans la fabrication des étoffes brochées et façonnées". The specification states that the inventor first made a machine of the type in 1790 and that at the date of the patent more than four thousand were in use in the neighbourhood of Lyons.

December 23, 1834.—The hansom cab is named after Joseph Hansom, whose first patent was granted on Dec. 23, 1834. The original cab was in the form of a sedan chair slung between large wheels with the driver's seat on the roof in front and a door at the back, the well-known construction being introduced with a second patent two years later granted to Gillett and Chapman, to whom the first had been assigned. A company was formed and started with 50 cabs, but was forced to compete with many imitators, in spite of several favourable verdicts in the courts.

December 24, 1836.—The name of Bennet Woodcroft will always be associated with the great reform of British patent law and practice that was brought about by the Amendment Act of 1852. Upon the passing of the Act, Woodcroft was appointed to the post of superintendent of specifications in the new department, and it was mainly through his enthusiasm and exertions that so many needs of the inventor were quickly met by a liberal interpretation of the new Act. To him is due the printing and indexing of the patent specifications, and he was also primarily responsible for the institution of the Patent Office Library and of the Science Museum. Before his association with the office, Woodcroft was a prolific inventor. One of his patents, dated Dec. 24, 1836, was for a process of printing calico with indigo, in which, to avoid the rapid oxidation which takes place, the operations were carried out in an atmosphere of coal gas.

December 24, 1866.—An early self-excited dynamo was that for which a British patent was applied for by Cornelius and Samuel Varley on Dec. 24, 1866. Two electro-magnets of horse-shoe form and two bobbins mounted on an axis are so arranged that when the bobbins are rotated they act simultaneously between the poles of the two magnets, a commutator serving to join up the whole into one continuous circuit. The residual magnetism is used to start the action. The application was not completed, but a patent was granted for the same invention on a second application made six months later.

December 24, 1877.—Edison's first United States patent for the phonograph was applied for on Dec. 24, 1877. The machine had a metal drum provided throughout its length with a fine spiral thread, over which a sheet of tin-foil was tightly pressed. A needle attached to a mica diaphragm rested on the tin-foil and recorded the sounds thereon. The specification describes the use of a clockwork motor, but the original machine made by Edison, which for some time was on loan to the Science Museum, South Kensington, was operated by hand.

Societies and Academies.

LONDON.

Society of Public Analysts, Dec. 4.—**A. P. Laurie**: The methods of examining pictures. An outline was given of the composition of the different pigments used for old illuminated MSS. and oil paintings, and methods of sampling by means of a micro-borer and examination by means of a microscope polariscope were described; a summary of micro-chemical tests for the various classes of pigments was given. The use of X-ray photography and ultra-violet rays was discussed, and it was shown how an examination of the brush strokes in an oil painting, considered in conjunction with the chemical and optical properties of the pigments, enabled a judgment to be formed as to whether the whole work had been produced in one studio and at the same period.—**S. Glasstone** and **J. C. Speakman**: The quantitative analysis of mixtures of nickel and cobalt. Electrometric titrations of nickel and cobalt solutions with potassium cyanide, with nickel and cobalt indicator-electrodes, respectively, have established the soundness of the theoretical basis of the Rupp and Pfennig method of determining these metals. A modified iodimetric method has also been developed for determining small amounts of cobalt in the presence of nickel.—**J. C. Baird** and **J. H. Prentice**: The changes with age of the hydrogen ion concentration of egg white and egg yolk. Determinations of hydrogen ion concentration by means of a quinhydrone electrode indicated that the normal *p*H value of fresh egg white is approximately 8·6, and that there is a rapid rise in the course of the first week of storage to a level of about *p*H 9·0, at which figure the reaction remains fairly constant. The fresh yolk has a reaction of approximately *p*H 6·0, which in the course of ten weeks rises to about 6·2. The refractive index of the egg white is constant at about 1·360.

PARIS.

Academy of Sciences, Nov. 12.—**Pierre Weiss, R. Forrer**, and **F. Birch**: The magnetisation to saturation of the nickel-cobalt alloys and the atomic moments of nickel and cobalt.—**de Sparre**: The necessity of taking into account the contraction on setting in the calculation of the work in armoured concrete.—**N. Lusin** and **W. Sierpinski**: The classes of the constituents of an analytical complementary.—**Georges Bouligand**: The successive fronts of an ensemble of points.—**A. Magnan** and **A. Sainte-Laguë**: New experiments on the resistance to the progress of fish in water. The experiments were carried out on 22 species of dead fish loaded so as to fall in water under the action of gravity: the motion was followed with a kinematograph. For most fishes the resistance was found to be constant, but with one, the ray, the resistance increased with the velocity.—**René Audubert**: The influence of the nature of the electrolyte on the potential of inversion of the photovoltaic effect.—**Mme. Ramart-Lucas**: The comparative stability of isomers according to their absorption spectra. The relation between the absorption in the ultra-violet and structure of the diaryl derivatives of ethylene and ethane. The ultra-violet absorption curves differentiate the structures of isomers with more certainty than any other physical property.—**G. Baeckeroot**: The presence of fossils of Aquitanian age in the scattered quartzite grits at the surface of the Moselle plateau.—**F. Labrousse** and **J. Sarejanni**: Changes of reaction and phenomena of oxido-reduction observed in the course of the development of some fungi. The increasing alkalinity of the culture medium shown by certain fungi is not due to the formation of ammonia. As regards the reducing power, all the fungi studied except one (*Thielavia basicola*) decolorise cresyl blue.—**Sébastien Sabetay**: The presence of β-ionone in a natural product. Commercial essential oil of *Boronia megastigma* contains a good proportion of β-ionone.—**A. Babes**: The thymus and growth.

CRACOW.

Polish Academy of Science and Letters, Oct. 7.—**Lad. Natanson**: The theorem of the Eiconnel and Fermat's principle.—**K. Kordylewski**: The variable star YY Sagittarii. The elements are calculated from 436 observations taken during 1925–29.—**J. Pagaczewski**: The variable star 259.1928 Cassiopeæ. The provisional elements calculated from 118 observations on 32 nights during 1928–29.—**J. Mergentaler**: The variable star XX Cephei. The provisional elements deduced from 147 observations during 1929.—**Wlad. Gorczynski**: The high values and energy losses of the solar radiation observed in desert regions and on tropical mountains.—**L. Chrobak**: Contribution to the technique of the X-ray examination of easily deformable crystals.—**Mlle. A. Dorabialska**: The application of the adiabatic microcalorimeter to measurements of the quantities of heat emitted by uranium, thorium, and radioactive minerals. The instrument used was capable of measuring thermal effects of the order of 10^{-4} to 10^{-5} calories per hour, and was applied to measuring the radiation of U_3O_8, ThO_2, and pitchblende.—**K. Dziewonski** and **T. Waszkowski**: Researches on α-methylnaphthalene.—**Mme. T. Cyge**: Anatomical and ecological studies on the leaves of indigenous orchids.—**K. Mielczarek** and **W. Brykalski**: The pollen analysis of Iwiec peat bog.—**Mlle. I. Toruwska**: Studies on the life of the iron bacteria.—**L. Ejsmont**: The two genera of Schistosomatides of birds.—**Z. Szantroch**: The histogenesis of the nerve ganglia of the heart.—**B. Dybowski**: Contribution to our knowledge of the Siberian seal.—**B. Dybowski**: The Polychætes of Lake Baikal.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 17).—**D. Beliankin**: Chemical degeneration of dinas. Analyses of a dinas brick subjected more than 600 times to the action of a furnace showed a considerable increase in Fe_2O_3, Fe_2O_5, and MnO, apparently received from the gases in the furnace.—**L. Lozina-Lozinskij**: The phenomena of chemotaxis in connexion with the choice of food by infusoria. The chemotactic reactions and the reactions of ingesting food particles have apparently a common physiological basis. Chemical properties of the substance used in the experiment have the same effect on the reactions of locomotion, digestion, and even of division, namely, either increasing or decreasing the rate of all these functions.—**A. Tsvetkov**: Changes in the coloration of apatites submitted to heating. If apatites are heated to 1700° C., regular changes in colour are observed, there being a definite colour corresponding to each stage of temperature. This is an unreversible process.—**S. F. Tsarevskij**: Contribution to the classification and distribution of the lizards of the genus *Phrynocephalus*. A study of the cranial characters permitted the author to evaluate them from the point of view of systematics, which so far have been based on external features only. *Ph. ludovici* Mocq. is regarded as identical with *Ph. axillaris*, and *Ph. erythrurus* Zugm. identical with *Ph. lidskii* Berd.—**J. Argentinovskij**: A new cinnabar ore deposit in the Urals. The new deposit has been discovered 118 km. north-west of Sverdlovsk (Ekaterinburg). The veins of the ore are included in quartz porphyrite. This is the third known deposit of cinnabar in the Ural mountains.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—**A. Angeli** and **Z. Jolles**: Reduction of normal diazo-hydrates. The formation of hydrocarbons from the corresponding normal diazo-hydrates by the action of weak reducing agents indicates that an unstable compound, such as phenyldi-imide, is formed as an intermediate step in the change. That this is actually the case is shown by the formation of s. benzoylphenylhydrazine when the reduction is effected in presence of benzaldehyde. Various other reactions are explainable similarly. The transformation of the normal diazohydrate into the compound $C_6H_5 . N : NH$ by reduction renders it probable that the hydrate has the structure, $NH : NO . C_6H_5$. It is possible to remove, not only the oxygen atom, but also, by the action of nitroxyl, the iminic residue from the diazo-hydrate.—**D. Th. Egoroff**: *W* congruences with regulated focals.—**M. Kourensky**: The method of integration of the equation to the partial derivatives of the second order with a single unknown function and two independent variables.—**A. M. Bedarida**: The theory of ideals of a finite algebraic body (3).—**B. Colombo**: Bianchi's problem regarding Lamé families.—**B. de Finetti**: Functions with aleatory increment.—**E. Raimondi**: A new phenomenon of aerodynamics.—**C. Cannata**: The ballistic hypothesis and the verification of the law of areas in the orbits of telescopic double stars. Any possibility of verifying the ballistic principle on the basis of observations on telescopic doublets is out of the question.—**M. Tenani**: Theoretical-experimental considerations on the course of the tides in the Adriatic (2). Experimental verification has been attained, in the case of the Adriatic Sea, of deductions previously drawn from theoretical considerations. This result, together with the calculation, of considerable practical importance, of the longitudinal displacements of the water during the day through the Straits of Otranto, confirms the possibility of extending analogous considerations and calculations to other seas.—**B. Rossi** and **G. Bernardini**: The photographic action of low-speed electrons. Using oiled Eastman plates, Kenneth Cole and other observers have found that low-speed electrons with velocity lower than that corresponding with 25 volts have no detectable effect on the photographic plate. By means of a special arrangement, the authors are able to photograph electrons with velocity 17·5 volts with ultra-sensitive Cappelli plates. Since the energy possessed by these electrons still greatly exceeds that necessary to affect a silver bromide granule, it is not improbable that this limiting voltage is capable of further reduction.—**F. de Carli**: Viscosity isotherms of binary mixtures (3): the system nitrobenzene-stannic chloride. Thermal analysis of this system confirms the formation of only one complex compound, $C_6H_5NO_2$, $SnCl_4$, melting at about $-11°$ C. The density isotherm for 15° reveals a sensible increase in volume, which denotes a dissociating action, probably due to the nitrobenzene. The viscosity isotherms for 15° and 25° exhibit distinct maxima, but the greatest divergences from the calculated values are shown by solutions containing about 50 per cent of nitrobenzene, whereas the compound formed contains 31·18 per cent. Thus, the maximum of viscosity is displaced towards the more viscous component, a phenomenon which is manifested by liquids in which the complex is highly dissociated. It may be, however, that molecules of the composition $2C_6H_5NO_2$, $SnCl_4$ exist in a stable form in the liquid state but decompose on solidification.—**G. Charrier**: Condensation of 1-amino-2-phenylazonaphthalene-4-sulphonic acid. Dehydrogenation of this acid, suspended in nitrobenzene, by means of an acetic acid solution of chromic anhydride, yields a sulphur-containing condensation product exhibiting the characters of a polycondensed ditriazole derivative. To this is attributed provisionally a constitution analogous to that of naphthylene dioxide, from which it may be theoretically derived by replacing the two oxgyen atoms by two SO_2 groups and attaching the 2-*N*-phenylated triazole nuclei, in the 1- and 3-positions of the triazole nucleus, in the 1- and 2-positions of the two naphthyls.—**E. Pace**: Organo-aromatic derivatives of boron. Descriptions are given of the methods of preparation and properties of: borophenyl chloride, $C_6H_5BCl_2$; phenylborine or boroaniline, $C_6H_5BH_2$, which readily oxidises in the air, giving monophenylboric acid; and borobenzene, $C_6H_5 . B : B . C_6H_5$, which decomposes in the air to form a pasty mass, probably boro-oxybenzene.—**G. Sani**: The reducing activity of roots of the Gramineæ (3): reduction of calcium nitrate. The reduction of calcium nitrate by maize roots is inhibited by the presence of small proportions of potassium hydroxide, chloroform, or formaldehyde, and also by heat or desiccation. In small quantity citric acid enhances the effect, but sulphurous acid is without influence. During the reduction the reaction of the medium changes from acid to alkaline, the alkaline product or products probably being the active agent in arresting the change.—**M. Anelli**: Covering phenomena in the Emilian Appenines.—**R. Savelli** and **N. Soster**: Sudden variations in the leaf form of *Cannabis sativa* L. Hemp exhibits two distinct variations of leaf shape, characterised by the replacement of the normal palmate type by a single margin, one being pinnatifid (lobed) and the other entire (simple leaf). The former represents a stable mutation, recessive with respect to normal, whereas the second must be regarded as a non-fixable sport, which affects whole plants or parts of plants and arises as a reaction to abnormal stimuli, with no necessary relationship to the pinnatifid form.—**Giulio Cotronei** and **Aldo Spirito**: Zoological constitution and grafting (1): Experiments with Anura and Urodela.—**Aldo Spirito**: Processes of regeneration and of regulation in the encephalic region of the embryos of Urodela (3). With *Triton cristatus*, at the stage of primary optical vesicle not yet introflexed, it is possible, by means of a technique outlined, to realise the regeneration of a more or less marked, entire prosencephalic wall. Such regeneration is followed by regulation phenomena which induce the formation of parts comparable with cerebral hemispheres, but neither with Anura nor with Urodela do the dimensions of the regenerated parts reach those of the corresponding normal parts.—**P. Pasquini** and **A. della Monica**: Regeneration of the crystalline in the larvæ of Anura. The faculty of regeneration possessed in the eye of Urodela, by the cells of the iris for developing a crystalline, is extended to Anura (*Rana* and *Bufo*), in the eye of which analogous phenomena are exhibited as a result of the removal of the normal crystalline: mainly the proliferation and consequent spreading of the leaflets of the iris, which lead to the metaplastic formation of a new lens. The latter is at first continuous with the iris, usually with the upper edge, but exceptionally also with the lower edge, but later becomes independent.—**M. Curzi**: A pseudo-rotting of the caryopsis of wheat. A sample of Arditi wheat, which had undergone auto-heating in the ear after reaping, was found to be attacked by *Acremoniella thermophila* n. sp., which is capable of developing between 30° and 52° C.

SYDNEY.

Linnean Society of New South Wales, Oct. 30.—A. Jefferis Turner: Revision of Australian Oenochromidæ (Lepidoptera) (1). The Oenochromidæ display considerable variation in structure and, being the most primitive Geometrites, they throw much light on the phylogeny, not only of the group as a whole, but also of the constituent families. In this first part of the revision, sixty-four species belonging to ten genera are dealt with, two genera and ten species being described as new.—Rev. H. M. R. Rupp: Variations in certain orchids. Attention is directed to frequent variations of *Dendrobium speciosum* Sm., and a form approaching *D. gracilicaule* F. v. M. is described as a new variety. Points of distinction are given between the northern form of *Prasophyllum intricatum* Stuart, and the typical form of the southern States. A red-flowering form of *Pterostylis ophioglossa* R. Br., confined to high gullies in stony hills, is described as a new variety.—Frederick H. S. Roberts: A list of the Australian Bombyliidæ of the subfamilies Exoprosopinæ, Anthracinæ, and Bombyliinæ in the German Entomological Museum, Berlin. The subfamily Exoprosopinæ is represented by the genera *Hyperalonia* Rond. (7 species), *Exoprosopa* Macq. (1 species), *Villa* Lioy (4 species), and *Pseudopenthes* Roberts (the genotype). The genus *Anthrax* of the Anthracinæ is included, two species being represented. Of the Bombyliinæ, *Bombylius* Linn. has two species, *Systoechus* Loew two species, and *Sisyromyia* White two damaged specimens.—A. M. Lea: Descriptions of new species of Australian Coleoptera (20). Forty-seven new species of the families Mordellidæ and Curculionidæ.—J. R. Malloch: Notes on Australian Diptera (22). Notes on members of the genera *Celetor*, *Dasyortalis*, *Duomyia*, *Euprosopia*, *Pterogenia*, *Naupoda* and *Lamprogaster* of the family Ortalidæ. A new subgenus of *Duomyia* and a new species of *Lamprogaster* are described.

VIENNA.

Academy of Sciences, Oct. 17.—F. Heritsch: The tectonic position of the Hochwipfel- and Nassfeld-facies in the carboniferous of the Carnic Alps.—A. Stock and W. Zimmermann: The vapour pressure of mercury at low temperatures.—F. Hernler: The three isomeric nitro- and amino-phenyl-1-dimethyl-3, 5-triazoles-1, 2, 4, and some of their salts.—L. Kober: Structural elements of the east and south Carpathians.—F. Blank and F. Urbach: Sols in crystals. To elucidate the formation of crystal-sols the solubility of gold in molten alkali halides was explored.—O. Abel: Explanation of the crawling tracks in the sandstone of Greifenstein near Kierling in the Wienerwald. Observations on the seashore of the South African coast in Algoa Bay near Port Elizabeth and in False Bay near Muizenberg in August and September of this year have led to complete explanations. The ebb-tide leaves a fine hard sand on which *Bullia* snail-shells leave their tracks.—A. Thiel: Sensitiveness and resistance to alkalis in phthaleins and sulphophthaleins.—H. v. Euler and B. Jansson: Catalytic hydrogen peroxide decompositions by metallic compounds.—G. Bredig, S. R. Carter, and M. Enderli: The equilibrium of carbon dioxide evolution from formic acid and its potential.—C. Neuberg and Max Scheuer: Detection and isolation of methyl-glyoxal formed biochemically as dioxime.—E. Berl and H. H. Saenger: The system N_2O_5-HNO_3.

Oct. 24.—H. V. Graber: Geological and petrographical researches on the Upper Austrian and Bavarian primitive rocks.—H. V. Graber: Mixed rocks from the Upper Austrian and Bavarian primitive rocks.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (5). The Raman spectrum of organic substances, C=O and C=C double-linkages, halogen derivatives; 27 substances were examined. An attempt was made to connect frequency with molecular structure.—S. Loewe and H. E. Voss: Preparation, properties, and testing of a male sexual hormone. A search for a male counterpart of the female thelykinin. The active substance is possibly soluble in water and weak acids as a colloid, freely soluble in alcohol, ether, and oil. Stable in aqueous solution for twenty-four hours, in organic solvents for at least some weeks. Not species-specific, preparations from testicles of ox and guinea-pig acting on mouse like mouse-products. The aqueous preparations lead to fatal general poisoning. The publication made now is a transcript of a communication deposited until seal in 1927, but now announced because others are publishing the effects of testis extract injection.—R. Singer: Progress and result of a botanical expedition to the Caucasus in 1929. The south-west region was explored: Gultschj, Kunjum, Schariwzek, Zuzchurtu, Taurari. The primitive forest finds its limit at 2000-2400 metres. A provincial museum at Sugdidi and a botanical garden near Batum proved helpful.—A. Steinböck: Hydrobiological work in the Tyrol alps. Alpine lakes were explored at and above 2000 metres. The fauna included Turbellaria and trout.—M. Beier: Results of a zoological expedition to the Ionian Islands and the Peloponnesus (1) and (2).

Oct. 31.—M. Beier and F. Silvestri: Results of a zoological expedition to the Ionian Islands and the Peloponnesus (3). Thysanura.—R. Kloimwieder: The tubular cells of Fumariaceæ, especially those of the genus *Dicentra*. These cells contain poisonous alkaloids. The plants seldom suffer from grazing or from fungus parasites. Feeding experiments on snails gave confirmatory results.—M. Blau and E. Rona: Communication of the Radium Institute (241). Further contributions to ionisation by H-particles.—K. Zentner: The efficiency of sand-blasts.

Official Publications Received.

BRITISH.

Ceylon Journal of Science. Section D: Medical Science. Vol. 2, Part 3: The Identification of the Land Snakes of Ceylon. By Dr. Lucius Nicholls. Pp. 91-157. (Colombo: Bacteriological Institute; London: Dulau and Co., Ltd.) 3 rupees.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1199 (Ae. 360): Skin Friction and the Drag of Streamline Bodies. By Prof. B. M. Jones. (T. 2709 and (a) and (b).) Pp. 12+8 plates. (London: H.M. Stationery Office.) 9*d*. net.

Modern Mining Explosives. Presidential Address delivered October 17th, 1929, by Dr. William Cullen. Pp. 36. (London: The Institution of Mining and Metallurgy.)

Proceedings of the South London Entomological and Natural History Society, 1928-29. Pp. xx+98+13+3 plates. (London.) 10*s*. 6*d*.

Sale of Food and Drugs Acts. Extracts from the Annual Report of the Ministry of Health for 1928-1929 and Abstract of Reports of Public Analysts for the Year 1928. Pp. 15. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 10, 1928. Pp. 132. (London.) 10*s*. 6*d*.

London School of Hygiene and Tropical Medicine. Report on the Work of the School for the Year ended July 31st, 1929. Pp. 36. (London.)

British Photographic Research Association. Report for the Year 1928-29. Pp. 15. (London.)

International Federation of University Women. Bulletin No. 11: Report of the Fifth Conference, Geneva, August 7 to August 14, 1929. Pp. 155. (London.)

Man and his World in the Light of Emergent Evolution: a Synopsis of the Course of Lectures delivered by Members of the University of St. Andrews under the Adult Education Scheme for Fife and Stirlingshire in 1929-1930. Pp. ii+57. (St. Andrews.)

Canada. Department of Mines: Mines Branch. Investigations in Ceramics and Road Materials (Testing and Research Laboratories) 1927. (No. 697.) Pp. ii+80. (Ottawa: F. A. Acland.)

Journal of the Chemical Society. November. Pp. iv+2425-2661+xii. (London.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929. Vol. 41, November. Pp. 687-781. (London.)

Journal of the Indian Institute of Science. Vol. 12A, Part 14: Studies in the Proteins of Indian Foodstuffs. Part 2: The Proteins of the Pigeon Pea (*Cajanus indicus*). By P. S. Sundaram, Roland V. Norris and V. Subrahmanyan. Pp. 193-205. (Bangalore.) 12 annas.

Proceedings of the Royal Irish Academy. Vol. 39, Section A, Nos. 1, 2: The Variation of Curvatures in the Deformation of a Curve in Riemannian Space, by A. J. McConnell; The Displacement or Deviation of Circles in Riemannian Space, by J. L. Synge. Pp. 20. 1*s*. Vol. 39, Section B, Nos. 3, 4, 5: The Action of Alcoholic Hydrochloric Acid on certain Unsaturated Ketones, by Brian Coffey and Dr. Hugh Ryan; The Constitution of Iso-catechin Tetramethyl Ether, by James J. Drumm, Robert J. P. Carolan and Dr. Hugh Ryan; On 3:4-Dimethoxylbenzyl-3:5-Dimethoxycoumaranone, by James J. Drumm, Sheila M. Maguire and Dr. Hugh Ryan. Pp. 107-123. 1*s*. Vol. 39, Section B, Nos. 6, 7, 8: Preparation and Oxidation of Flavindogenides, by Dr. Hugh Ryan and George Cruess-Callaghan; Some Derivatives of γ-Anisylidene-Methylethylketone, by Dr. Hugh Ryan, Peter M'Geown and Dr. John Keane; The Condensation of Aldehydes with Benzyl Acetoacetic Ester, by Dr. Hugh Ryan, W. B. Cornelia and Pierse Hurley. Pp. 124-145. 1*s*. Vol. 39, Section B, Nos. 9, 10: Some Effects of Röntgen Rays on Seedlings, by Dr. Sylvia B. Wigoder and Ruth Patten; Further Study on the Effect of Summer and Winter Temperatures on the Catalase of Pine Needles; a Reply to Criticism, by F. C. Green, M. E. M'Endarfer, O. S. Orth and W. E. Burge. Pp. 146-159+plates 3-4. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Department of Agriculture, Ceylon. Bulletin No. 85: The Termite-proof Construction of Buildings in Ceylon. By F. P. Jepson. Pp. iv+36+26 plates. (Peradeniya.) 40 cents.

Report on the Administration of the Meteorological Department of the Government of India in 1928-29. Pp. 19+4 plates. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1*s*. 6*d*.

Royal Agricultural Society of England. Agricultural Research in 1928. Pp. viii+193. (London: John Murray.) 1*s*.

Report on the Conditions of Science Teaching in Oxfordshire. Compiled by a Committee of the Oxfordshire Branch of the Incorporated Association of Assistant Masters in Secondary Schools. Pp. 8. (Oxford.)

Royal Agricultural Society of England. Report of the Council to the Annual General Meeting of Governors and Members of the Society, to be held at the Royal Agricultural Hall, Islington, London, N., on Wednesday, December 11, 1929, at 2.15 p.m. Pp. 26. (London.)

Harper Adams Agricultural College, Newport, Salop, 1929-30. Pp. 96. (Newport, Shropshire.)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Salop. A Progress Report of Instructional and Experimental Work in Poultry and Rabbit Husbandry. No. 2, August. Pp. 72. (Newport, Shropshire.)

Proceedings of the Royal Society. Series A, Vol. 126, No. A800, December 2. Pp. 183. (London: Harrison and Sons, Ltd.) 6*s*.

Proceedings of the University of Durham Philosophical Society. Vol. 8, Part 2, 1928-1929. Pp. 71-159. (Durham.) 5*s*.

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1924, under the direction of Dr. S. K. Banerji. Pp. v+133+5 plates. (Calcutta: Government of India Central Publication Branch.) 6.10 rupees; 11*s*.

FOREIGN.

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico, Anno 1923. Pp. viii + 218. Boletim Meteorologico, Anno 1924. Pp. viii+224. (Rio de Janeiro.)

Methods and Problems of Medical Education. (Fifteenth Series.) Pp. iv+76. (New York: The Rockefeller Foundation.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 14: Statistics of Teachers Colleges and Normal Schools, 1927-1928. Prepared by Frank M. Phillips. Pp. 71. 10 cents. Bulletin, 1929, No. 27: Review of Educational Legislation, 1926-1928. By Ward W. Keesecker. Pp. 20. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 76, Art. 6: New Species of Buprestid Beetles from Costa Rica. By W. S. Fisher. (No. 2803.) Pp. 20. Vol. 76, Art. 16: Oölites or Cave Pearls in the Carlsbad Caverns. By Frank L. Hess. (No. 2813.) Pp. 5+8 plates. (Washington, D.C.: Government Printing Office.)

Comité National Français de Géodésie et Géophysique. Assemblée générale du 27 mars 1929. Compte rendu publié par le Secrétaire général G. Perrier. Pp. 64. (Paris.)

Wisconsin Academy of Sciences, Arts and Letters. The Fresh Water Mollusca of Wisconsin. By Frank Collins Baker. Part 1: Gastropoda. (Wisconsin Geological and Natural History Survey, Bulletin 70, Part 1.) Pp. xx+507+28 plates. Part 2: Pelecypoda. (Wisconsin Geological and Natural History Survey, Bulletin 70, Part 2.) Pp. vi+495+plates 29-105. (Madison, Wis.)

Meddelelser fra Kommissionen for Havundsøgelser. Serie Fiskeri. Bind 8, Nr. 6: An Investigation of the Stock of Plaice in the Southern Horns Reef Area in the Years 1925 and 1927. By Aage J. C. Jensen. Pp. 63. 4.50 kr. Bind 8, Nr. 7: On the Age and Growth of the Coalfish (*Gadus virens* L.), the Norway Pout (*Gadus esmarki* Nilsson) and the Poutassou (*Gadus poutassou* Risso) in Icelandic Waters. By Bjarni Sæmundsson. Pp. 37. 3.65 kr. Bind 8, Nr. 8: On the Influence of the size of the Stock of Cod upon the Yield of the Herring Fishery in the Kattegat, Belt Sea, and Western Part of the Baltic, and some other Causes of Variations in the Cod and Herring Fisheries. By Aage J. C. Jensen. Pp. 16. (København: C. A. Reitzels Forlag.)

The Rockefeller Institute for Medical Research. Organization and Equipment. Pp. 27+2 plates. (New York City.)

U.S. Department of Agriculture. Technical Bulletin No. 112: Biology of the Cotton Boll Weevil at Florence, S.C. By F. A. Fenton and E. W. Dunnam. Pp. 76. 20 cents. Leaflet No. 48: Reindeer Recipes. By Louise Stanley and Fanny Walker Yeatman. Pp. 8. 5 cents. (Washington, D.C.: Government Printing Office.)

Records of Changes in Color among Fishes. By Charles Haskins Townsend. (New York Aquarium Nature Series.) Pp. 58 (27 plates). (New York: New York Zoological Society.)

Proceedings of the Boston Society of Natural History. Vol. 39, No. 5: Experiments in Bird Migration. i. Manipulation of the Reproductive Cycle; Seasonal Histological Changes in the Gonads. By William Rowan. Pp. 151-208+plates 22-32. (Boston, Mass.)

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 133: Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung. Jahrgang 1926, Neue Folge, Band 63 (der ganzen Reihe Band 71). Pp. xx+A42+B54+C44+D7. (Wien: Gerold und Komp.)

Parki Narodowe w Polsce: National Parks in Poland. By Władysław Szafer. Pp. 31. (Kraków: Nakładem Państwowej Rady Ochrony Przyrody.)

Państwowa Komisja Ochrony Przyrody w Polsce: State Commission for the Protection of Nature in Poland. Nr. 8: On the Protection of Nature in Poland during the last Five Years, 1920-1925. By Prof. Dr. Władysław Szafer. Pp. 54. Nr. 24: Loi pour la protection de la nature en Pologne. Par Jan Gwalbert Pawlikowski. Pp. 11. (Kraków: Nakładem Państwowej Komisji Ochrony Przyrody.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 66: Formeln und Tafeln zur Bestimmung parabolischer Bahnen. Von Bengt Strömgren. Pp. 146. (København.)

U.S. Department of the Interior. Education Bulletin, 1929, No. 32: Developments in Rural School Supervision. By Annie Reynolds. Pp. v+17. (Washington, D.C.: Government Printing Office.) 5 cents.

The University of Chicago: Publications of the Yerkes Observatory. Vol. 7, Part 1: Radial Velocities of 500 Stars of Spectral Class A. By Edwin B. Frost, Storrs B. Barrett and Otto Struwe. Pp. vii+79. (Chicago: University of Chicago Press; London: Cambridge University Press.)

United States Department of Agriculture. Technical Bulletin No. 86: Imported Insect Enemies of the Gipsy Moth and the Brown-tail Moth. By A. F. Burgess and S. S. Crossman. Pp. 148+6 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

CATALOGUES, ETC.

Calendar for 1930. (London: British Museum (Natural History).)

Scientific Instruments. Pp. 80. (Delft: P. J. Kipp en Zonen.)

Diary of Societies.

FRIDAY, DECEMBER 20.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Determination and Isolation of the Picture.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Challis: Line Signalling on the Southern Railway.

SOCIETY OF DYERS AND COLOURISTS (Scottish Section).—P. Urmston: Modern Machinery in Dyeing, Printing, and Finishing.

PAPER MAKERS' ASSOCIATION (Technical Section, Northern Division) (at Engineers' Club, Manchester).—R. H. Clapperton: The Elimination of Dirt from Paper Stock.

SATURDAY, DECEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (1): The Elementary Use of Nature.

CONFERENCE.

DECEMBER 20 AND 21.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at London School of Hygiene and Tropical Medicine).

Friday, Dec. 20, 10 A.M. to 1 P.M.—A. D. Ritchie: Reflex Movements in Pecten.—G. S. Carter: Thyroxin and Fertilisation in *Echinus*.—F. C. Stott: Temperature Optima in Invertebrate Digestive Enzyme Reactions.—F. C. Steward: Diffusion of Substances through Membranes of Plant Tissue.—M. C. Pratt: Production of Formaldehyde in Photosynthesis.—H. R. Hewer: Variation in the Genus *Zygæna*.

2.15 to 3.45.—M. Robertson: The Action of Acriflavine on *Bodo caudatus*.—A. B. Appleton: The Nutritional Factor in the Growth and Differentiation of the Skeleton of the New-born Rabbit.—H. G. Newth: The Feeding of Ammocœtes.

3.45 to 5.15.—*Demonstrations:*—Dr. V. J. Wigglesworth: The Formation of the Peritrophic Membrane in Insects.—Dr. P. A. Buxton: Apparatus for Exposing Insects to Known Temperatures and Humidities.—Dr. G. S. Wilson: (*a*) Apparatus for the Continuous Passage of Gaseous Mixtures of Variable Composition through Liquid Cultures of Bacteria; (*b*) Apparatus for the Cultivation of Bacteria in Closed Atmospheres of Known Composition.—Major H. C. Brown and Dr. J. C. Broom: Portable Apparatus for the Determination of Hydrogen Ion Concentration.—Dr. A. Robertson: *Trypanosoma cruzi*, isolated from an Opossum in Honduras.—H. N. Howes: Histological Methods for Investigating the Activity of the Anterior Pituitary.—Dr. G. P. Crowden: (*a*) Audiometers for Testing Acuity of Hearing; (*b*) Whipple's Test for Steadiness of Hand; (*c*) Lehmann-Muller Closed Circuit Metabolism Apparatus.

5.15 to 6.15.—W. Robinson: Problems of Nutrition and Development in some Brown Seaweeds.—V. C. Wynne Edwards: On the Waking-time of the Night-jar.

At 6.15.—Annual Meeting.

Saturday, Dec. 21, 10 A.M. to 1 P.M.—E. A. Spaul: The Distribution of Biological Activity in the Anterior Pituitary.—G. Pincus: Observations on the Living Eggs of the Rabbit.—E. M. Stephenson: The Physiology of Crustacean Chromatophores.—R. H. Stoughton: Cytology of *Bacterium malvacearum*.—G. Fox Wilson: Biology of *Tylenchus dipsaci* in its Relation to Herbaceous Plants.

NATURE

SATURDAY, DECEMBER 28, 1929.

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Pleistocene Man in China.

NEWS arrived by cable on Dec. 15 of the discovery in the cave at Chou Kou Tien of the fossilised fragments of ten more examples of *Sinanthropus*, certainly the most remarkable find of early Pleistocene human remains that has ever been made. Amongst these is said to have been a complete skull with both the cranial and facial bones perfectly preserved. This discovery was made by a group of geologists and anthropologists representing the Geological Survey of China and the expedition endowed by the Rockefeller Foundation.

The credit of recognising the importance of the site where these fossils have been found belongs to Prof. J. G. Andersson, the Swedish geologist, who, in conjunction with Dr. Grainger, the palæontologist of the American Museum of Natural History, surveyed the field in 1927. Continuing the investigation, Prof. Andersson, in association with his fellow-countryman Dr. Birger Bohlin, who is now a member of Sven Hedin's expedition in eastern Asia, found the first tooth of the Peking man for which Prof. Davidson Black, of the Peking Union Medical College, created the new genus and species *Sinanthropus pekinensis*. This discovery, and also that of a second tooth, have already been described by Prof. Davidson Black in our columns (NATURE, Nov. 20, 1926, p. 733, and Dec. 31, 1927, p. 954). A year ago fragments of two skulls, one of a child and one of an adult, including parts of the jaws and of the brain cases, afforded a definite confirmation of the validity of Davidson Black's new genus. Now comes the astounding discovery of remains of ten individuals, which should provide the material for the study of early Pleistocene man such as anthropologists hitherto had scarcely ventured to hope to find.

In a recent letter Dr. Davidson Black stated that before Aug. 31 a number of interesting finds had been made at Chou Kou Tien, including six beautifully preserved teeth of *Sinanthropus* forming part of an additional individual, that is, additional to the two originally discovered and some yards away from the spot where they were found. Father Teilhard and Mr. Young have almost completed the preliminary report on the geology of the deposit, and it was hoped to have this report, for the writing of which Father Teilhard is responsible, published before Christmas. This very important step in the programme of research will be followed by a revised and extended list of the fauna which it is expected will be ready before next spring. The material which is now prepared for investigation is

so rich that most of the doubts about the identification of the species of animals will be cleared up and many additions will be made to the earlier list prepared by Dr. Zdansky.

The work has grown to such proportions that it has been necessary to extend the laboratories at the Peking Union Medical College to make room for no less than twenty-five technical assistants who are engaged in developing the fossil remains of the associated fauna. Prof. Davidson Black himself is doing all the preparatory work on the human material, which will take many months to develop. His communication, to which reference has already been made, was written six weeks before the new material announced by cablegram on Dec. 15 came to light. With this extraordinarily rich material we are promised a most important contribution to our knowledge of one of the three earliest members of the human family that have so far been discovered. On Dec. 29 Prof. Davidson Black will make an official statement on the new discoveries.

Science in Crop Production.

The Application of Science to Crop Production: an Experiment carried out at the Institute of Plant Industry, Indore. By Albert Howard and Gabrielle L. C. Howard. Pp. v + 81 + 12 plates. (London: Oxford University Press.) 9*s*. net.

IN many countries, up to the War period, the career of agricultural research was one of struggle and piecemeal growth. Exceptions were to be found in the steady evolution of research institutes in some European countries; the United States had inaugurated a wide organisation; and in India an interesting feature was the establishment of certain 'central' research stations. Tropical agricultural research was, in general, under neglect. The decade now ending will always stand out as a period of informed interest and of determination to develop agriculture by application of the sciences. It is of the British Empire that this is particularly true, and the Imperial Agricultural Research Conference of 1927 may prove to merit a permanent place in the history of agricultural development.

Movement has been in a number of directions. Apart from expansion of existing centres, there has come 'industry' research as exemplified in the Empire Cotton Growing Corporation's Research Station in Trinidad and the Rubber Research Institute in Malaya. The new Amani Institute in East Africa represents a novel form of 'central' research station, while the Imperial College of Tropical Agriculture in Trinidad gives the Empire its first tropical training ground. Agricultural research councils have recently been set up for the non-self-governing colonies and for India. From this new activity are emerging many problems, ranging over finance, the sciences, organisation, and local political situations, and extending down to the recruitment, training, and status of the research worker. This is pre-eminently, therefore, a time which makes welcome any logical survey of the methods of inaugurating and conducting agricultural research on a large scale.

In the volume before us, Mr. and Mrs. Howard relate the story of the genesis, scope, and experimental work of the recently founded Institute of Plant Industry at Indore, Central India. Central India, a group of Indian States, is a large tract in which 'black cotton soils' predominate. In 1919 it was decided to found an agricultural research station for the whole area, and Mr. Howard became Director of the Institute and Agricultural Adviser to States in Central India and Rajputana. Gifts of land and money were made by the States, and in 1924 the recently formed Indian Central Cotton Committee provided buildings and equipment and guaranteed a substantial annual income. By 1928 the Institute was incorporated and made fully autonomous; it is now financed by subscription and controlled solely by the subscribers. Thus was removed one of the difficulties of organised research, and one which the authors believe to have been a grave defect in British India, namely, the oppressive official control of work and organisation by way of official control of funds. The circumstances of Central India made the broad task of the Institute clear. Work was concentrated upon cotton and along the following main lines: fundamental investigations on cotton, especially in relation to the characteristics of black soils and the production of improved varieties for those soils; the training of post-graduates and others; and the general stimulation of agricultural development in Central India.

General policy and development at Indore are of especial interest when taken as an illustration of the general case. The major considerations which are steadily associating themselves with large-scale agricultural research are grouped round experimental policy; organisation including finance; and the means of projecting research results into farming practice.

Upon experimental policy there are two rather divergent schools of thought. One would content itself with finding really competent research workers in the various sciences and giving them full working

facilities and full freedom. It argues that all fundamental advances must in time inspire improvements of practice and that economic applications arise, and may be left to arise, unexpectedly from unfettered research. In contrast, the second school favours a survey of the economic situation and the practices of production, in the light of which a limited number of urgent but approachable problems should be selected. Experimentation should then be specifically directed to these problems. It should commence with a strong 'applied' bias and gradually find its way into the underlying fundamental scientific problems. In support of this it could be urged that any crop or domesticated animal offers literally infinite scope for experiment; that resources are limited; and that, therefore, the direction of research must to a fair extent be prescribed. In brief, the problem of guiding experimental policy is to maintain a live connexion with the practices of agriculture without depriving research of that measure of freedom which is vital to all scholarship. Flexibility of outlook is the fundamental necessity, for time and circumstance are bound to give suitable scope to both the alternative attitudes. At Indore, it is clear, faith in the man rather than the organisation has been the guiding principle; and yet the economic bias has not been forgotten, for science is being applied to crop production by progressive analysis of a number of clearly defined practical problems.

The organisation of a research institute involves finance, government, internal administration, staffs, buildings, and equipment. In connexion with each of these, current practice varies widely among agricultural research centres. Indore, by reason of the agricultural and political circumstances of Central India, is saved from many of the difficulties familiar elsewhere. It is, none the less, an extremely interesting example. In finance there is complete autonomy, and to this the authors attach great importance. By most praiseworthy restraint the Board of Governors has been limited in number to seven, of whom one, the Agent to the Governor-General in Central India, is *ex-officio* president. Three of the members represent the constituent States and three the Indian Central Cotton Committee. This body, small, and directly concerned in the ultimate aims of the Institute, may perhaps be looked on as, in principle, ideal of its kind. For it is unlikely to lose touch with essential aims by dissipating itself into committees the time of which is taken up by the *minutiæ* of internal administration. One of the most interesting chapters in the volume describes the lay-out and development of land and buildings, the stock, the equipment, and the working material in general. It is a rare and valuable guide for future undertakings.

How to project research results into agricultural practice is the remaining major consideration. Its great importance has in the past rarely been appreciated either by the research worker or by government or other financing body. In England it has been by no means neglected, and yet there are many farmers who, in such familiar practices as the use of fertilisers, still fail entirely to profit from the clear-cut principles which have long been familiar to science. At Indore the general problem has been resolved into liaison on one hand and the scope and status of the Station on the other. Students trained and sent out into the States are regarded as the most effective agents for liaison with the supporters of the Institute. With the help of a certain number of scholarships, it has been possible to commence the training of Indian university graduates as specialists in cotton. Agricultural officers and subordinates are urgently needed for the contributing States, and arrangements have been made to train present occupants of these posts and to recruit new ones. The aim is not so much to afford a knowledge of agricultural science as to stimulate an informed interest in the development of the countryside. A novel and most valuable feature has been a short course for a certain number of State officers connected with the revenue departments. Training, or the making of liaison agents, is extended even to the cultivator. The labour staff of the Institute is maintained as a fluid body from which trained men are gradually drafted to the districts where, in various capacities, they are expected to become the foci of an improved agriculture.

Indian experience has made clear, the authors feel, that a 'central' research station as formerly conceived, cannot succeed. Unless it produces results of economic value it will sink in the general estimation and lose financial support. But if it produce such results, how is it to ensure that they are adopted in practice? In British India the provincial stations are the only medium available. These, however, have duties, interests, and researches of their own, and, in effect, cannot subserve the central station. It is urged, therefore, that, together with the central station for any 'area', there should be established demonstration farms in the component 'districts'. These should engage in no scientific work, but concentrate on inducing the cultivator to adopt the improvements emanating from the central station. Indore is conceived

upon these lines and the States are providing the necessary demonstration farms. It is, perhaps, a fair criticism that in some countries this simple partition of 'research' and 'demonstration' would offer difficulties. Men sufficiently competent and interested to have charge of demonstration farms and propaganda would not always be willing to eschew investigation and subdue originality. Moreover, for areas varying sharply from place to place in soil and other circumstances, full experimental confirmation of central station results in representative districts would be essential.

Of actual experimental achievement, despite the short life of the Institute, there is a good deal to show. The comprehensiveness of the policy is a noteworthy feature, and the essential aim is to study the cotton plant as actually grown by the cultivators. Improved varieties usually offer, in circumstances of somewhat backward husbandry, the readiest chances of advancing agriculture, and, provided a seed supply be organised, they are the swiftest means of gaining the cultivator's good will. But, even in India, increases in yield from improved varieties are usually of the order of only 10 per cent. Far more substantial increases may be effected by cultivational improvements, and the authors hold that on the black soils better methods may be expected to double the output per acre of cotton. With plant breeding are therefore linked extensive studies upon weed eradication; upon the control of water during the monsoon to prevent erosion and soil deterioration; upon soil permeability; and upon the organic matter content of black soils. It is believed—and the experiments now bear witness—that in these four questions are to be found the essential limitations to output per acre. Well-irrigation, the maintenance and improvement of stock, and appropriate ploughs, crushing mills, and other mechanical appliances, are further subjects of investigation. To ensure that improvements in these directions pass into practice, the Institute arranges supplies to cultivators on simple financial terms.

In each of the fields selected the experimentation projected or in progress is very comprehensive. Moreover, while closely regarding the underlying fundamental scientific questions, it is directly linked with the circumstances of husbandry. Plant breeding is based upon a study of all obtainable forms of Indian cotton, to which will be added, later, other Old World cottons. Botanical surveys of Indian cottons have already been made, but these, for plant breeding and husbandry, are of no more than cataloguing value. The quality or manufacturing characteristics, the adaptation to soil, season, and cultivational practice, and resistance to diseases and pests, are of first importance. To all of these close attention is being given, and this wide survey must inevitably assist improvement in many branches of crop production.

The Indore Institute is itself an experiment. Its avowed aim—the application of science to crop production—is clearly reflected in both general organisation and experimental policy. Some of its features are novel, and some have been pre-determined by the circumstances of the area it serves. As an agency—the central agency—in the agricultural advancement of Central India, its strong potentialities are already manifest. As a new model it will claim the close interest of all to whom it falls to create or maintain centres of agricultural research.

F. L. ENGLEDOW.

Sir Ronald Ross and Malaria.

(1) *Studies on Malaria.* By Sir Ronald Ross. Pp. xii + 196 + 4 plates. (London: John Murray, 1928.) 5*s*. net.

(2) *La découverte de la transmission du paludisme par les moustiques.* Par Sir Ronald Ross. (Une grande page de l'histoire de la médecine.) Préface et traduction de l'anglais par Dr. Charles Broquet. Pp. 175. (Paris: Norbert Maloine, 1929.) 20 francs.

(3) *Letters from Rome on certain Discoveries connected with Malaria.* By Dr. T. Edmonston Charles, and Addenda, consisting of an article by S. Calandruccio, letters from Robert Koch and A. Laveran, and a statement by Lord Lister. Edited, with a Preface and Remarks, by Sir Ronald Ross. Pp. 78. (London: Sir Ronald Ross, Ross Institute and Hospital for Tropical Diseases, 1929.)

(1) SIR RONALD ROSS has prepared this summarised and readable account of his work on malaria for the benefit of numerous correspondents who desire a small and convenient volume on the subject. In the first chapter the earlier years of the author up to 1894 and the work of Laveran and Golgi are briefly reviewed, and in the second and third Sir Ronald describes the difficult conditions under which his observations on the development of the parasites of malaria in mosquitoes were begun and carried on in India. The next chapter is a re-statement of the unfortunate controversy with the late Prof. Grassi and his colleagues.

In 1899, Ross arrived in England and was

appointed lecturer on tropical medicine in Liverpool, and almost at once went out on the first expedition to Freetown. He describes his observations and the lack of response on the part of the Colonial Office to representations in regard to measures based on these observations, and the cheering effect of the gift of £2000 from Mr. Coats for a year's trial of the plan for mosquito control. The second expedition to Freetown was then planned as an object-lesson in mosquito reduction, and an account follows of the work of Dr. Logan Taylor there. Visits were made to Lagos and the Gold Coast, where Sir Ronald records that he had a more appreciative reception, and to Ismailia, where methods for mosquito reduction were entirely successful. Visits followed to Panama, to see the results of the work of Gorgas, and to Greece and Mauritius.

Ross resigned in 1912 the chair of tropical medicine in Liverpool, which he had held for ten years, and commenced practice in London. War service, the petition by the author for a monetary compensation for his work, and the foundation of the Ross Institute in 1923 are briefly dealt with, and in a final chapter is a summary of the main facts about malaria. A list of 108 references is appended.

(2) This is a translation of "Researches on Malaria", prepared by Ross for his lecture in Stockholm in December 1902, when he received the Nobel Prize, and reprinted in the *Journal of the Royal Army Medical Corps*. Ross's drawings of the stages of the malaria parasite in the mosquito are reproduced in nine plates and seven text figures. In the preface Dr. Broquet gives a short biography (28 pp.) of Ross and a review of his chief works.

(3) The letters from Rome were first privately printed in 1900, but only a few copies were issued —in February 1901. The present edition is prepared for "those who study the history of medicine and who prefer truth to fiction". The letters, eight in number, were written from Rome by Dr. Charles to Major Ross in Calcutta between Oct. 4, 1898, and Jan. 14, 1899. Dr. Charles reported to Major Ross the investigations on human malaria then being carried out in Rome by Prof. Grassi and his colleagues, and he obtained from Ross specimens of the mosquitoes studied by him in India and from Manson one of Ross's microscopic slides showing zygotes of *Proteosoma*—the organism of bird malaria the cycle of which was the subject of Ross's work in India. These specimens and others sent by Ross to Charles were shown to Grassi and his colleagues. Dr. Charles, in fact, acted as the intermediary between Ross and Grassi for the ten weeks covered by the letters.

In the second of two postscripts, Ross states that "the whole of the Italian work depended on my discovery of the zygotes", and that when the Italians "took up the work it no longer presented any serious difficulties". That is Ross's position and is the reason for the republication of these letters. As Profs. Grassi and Bignami, the chief two Italian workers, are dead, it would be well to let the controversy cease.

Appended is a list of publications on the transmission of malaria, bearing dates from Dec. 8, 1894, to Dec. 22, 1898—the period concerned in the discussion of priority.

Reform of the Calendar.

(1) *Report of the National Committee on Calendar Simplification for the United States, submitted to the Secretary of State, Washington, August 1929.* Pp. 119. (Rochester, N.Y.: National Committee on Calendar Simplification, 1929.)

(2) *Thirteen-Month Calendar.* Compiled by Julia E. Johnsen. (The Reference Shelf, Vol. 6, No. 4.) Pp. 201. (New York: The H. W. Wilson Co., 1929.) 90 cents.

IF one may judge by the publications before us, the question of reforming the calendar has made considerably more headway in the United States than in Great Britain. The American National Committee was formed in response to a suggestion received in 1927 from the League of Nations. From the beginning, Mr. George Eastman, of the Eastman Kodak Company, took a keen part in its organisation, and became its energetic chairman. The composition of the committee was fairly representative of all interests, with one rather significant exception. It was not found practicable to include a section to represent the views of the various religious bodies, and the attempt was frankly abandoned.

The result of circulating a questionnaire and collecting already existing evidence on the subject is to show a wide interest in calendar reform on the part of a large body of American opinion. So far as this favours a particular plan, it is the fixed calendar of thirteen months which finds the largest measure of support. As this is the most drastic type of scheme and is open to the most obvious superficial objections, and alternative schemes are passed over very lightly, the impartiality of the committee may not appear above suspicion. But its practical conclusion is that a decision can

only be arrived at by an international conference, that the United States Government should express its willingness to participate at an early date, and that the American representatives should not be committed to any particular scheme of reform. No other view, except a purely negative one, is possible, for it may be taken as common ground of all enlightened opinion that any contemplated change must be introduced universally and simultaneously.

The extent of the propaganda behind the movement in favour of a calendar of thirteen months is shown perhaps even more clearly in the second volume, which gives in a clearly arranged form a summary of the arguments (for and against) reduced to heads, bibliographical notes, and excerpts from the literature of the subject. This should be found very useful and instructive. The desire for a change comes most urgently from the part of those concerned in business management, and naturally from those quarters where it has been found most convenient to adopt a month of four weeks as the unit of accounts. Perhaps the arguments based on experience in this connexion sometimes overshoot their mark. Thus the comptroller of the Western Clock Company has pointed out very cogently the advantages which have followed from adopting this system in his business. But these have been gained by a domestic arrangement equally open to others, with little or no hindrance arising from the anomalies of the present calendar. There is much scope for the judicious use of a private calendar, designed for special needs, without waiting for a revolution which may be a long time in coming. In the domain of meteorological statistics, for example, it is conceivable that the adoption of some world-wide scheme by agreement would confer greater advantages than those which may be expected to follow automatically from the introduction of a new civil calendar.

The movement is not free from the two-edged and even sordid type of argument to which the ardent propagandist is prone. A specimen may be quoted :

"It should increase your business. When the new calendar is in general effect all monthly periodicals would be issued thirteen times a year instead of twelve.

"There will be an increase in the amount of printing of bills, statements, etc."

Such arguments may account for some of the definite support behind the movement, but they will scarcely advance the case. Nor is the argument that a reformed calendar would be more scientific in the least impressive. To smooth out the existing irregularities of the present calendar is too simple a task to present a scientific problem, and men of science will be the last to allow their own interests any excessive weight in the solution of it. The question is mainly social and religious, and must be decided by political and religious agreement. In the meantime, the fixing of Easter within narrow limits, a simple object of some importance to many, seems likely to be hindered indefinitely by the search for an ideal calendar acceptable to all interests.

H. C. P.

New Six-Language Technical Dictionary.

Pitman's Technical Dictionary of Engineering and Industrial Science in Seven Languages—English, French, Spanish, Italian, Portuguese, Russian and German. Compiled by Ernest Slater. Vol. 1 : *A-Dec.* Pp. x + 581. Vol. 2 : *Dec-Knu.* Pp. iii + 582-1155. Vol. 3 : *Lab-Rib.* Pp. iii + 1156-1727. Vol. 4 : *Rib-Zon.* Pp. iii + 1728-2211. (London : Sir Isaac Pitman and Sons, Ltd., 1928–1929.) 4 vols., £8 8*s*. net.

THIS monumental work is more than a mere dictionary, and certain of the preliminary sections might be read with advantage by all who have to do with the translation of technical matter into foreign languages or have business relations with firms abroad.

The book originated with a small group of translators—most of them trained engineers—who took as their basis a list of terms collected abroad during some years and amplified this by reading and marking journals and text-books of the various countries in question. This procedure, supplemented by correspondence with engineers in other countries, has given the foreign equivalents, not merely for ordinary engineering terms, but also for many workshop slang expressions.

The first intention was to treat of each branch of engineering in a separate volume, the inclusion of the whole in a single book being decided on when it was found that about 60 per cent of the entries for any branch must consist of more or less general engineering terms. Thus, the volume on steam engines would not be complete without considering pipes and pipe-joints, which would be equally essential when treating of water or gas engineering, and such matters as plates, rivets, bolts, and girders figure in many departments of engineering.

The dictionary proper is preceded by several

sections in which special difficulties are discussed. Section 1, "The Art of Technical Translation", furnishes useful information as to the way many of the expressions in common use are to be converted into the corresponding foreign phrases. Section 2, on "Alternatives, Refractory Idioms, and Peculiar Phrases", considers the correct renderings of: alternating, back gear, booster, coal of various grades, control, efficiency, head, jam, oil, patch, soldering and brazing, temper, tool, weir, and a number of other terms, of which the translation into certain languages demands special care.

Section 3 gives a record of untranslatable English words adopted in their original form into other languages, while Section 4 indicates how phrases referring to mechanical motion, relation, position, cause and effect, are expressed in each language; idiomatic forms commonly used in advertising are also included here. In Section 5 there is laid down a guide to common engineering abbreviations, and to technical and scientific signs, contract conditions, specification matter, engineering slang, shop terms, etc.

The dictionary itself extends over more than 2100 pages ($9\frac{1}{2} \times 7$ inches), each of four columns, one side being devoted to English-French-Spanish-Italian and the opposite one to English-Portuguese-Russian-German. This arrangement has involved duplication of the English column, but it prevents the confusion that might arise from faulty alinement. Every page contains from forty to fifty entries.

As regards most branches of engineering, the book appears to be as nearly complete as it is possible to make it. Entries relating to air, for example, occupy six, to coal more than six, to oil six, and to sugar four sides. On the other hand, although the sub-title includes the word chemistry, the list of terms relating to chemical engineering subjects is not nearly so full as might be desired. To take the important question of distillation alone, the terms reflux and drip-pipe are missing, and for bell the French equivalent is given only as 'cloche', 'calotte' not being mentioned. Such terms as cream of tartar, nitre, soda ash, and pyroligneous acid are found, but salt cake, vinegar, brewing, and a number of others are absent.

The book has been well produced and opens well at any page. The type in the main body of the dictionary, although clear, is rather small, but this is doubtless due to the necessity for keeping the bulk within reasonable limits. In the Russian column the old spelling, not that now in use in Soviet Russia, has been adopted. A few minor misprints have been noticed, but in general great care has been taken in the correction of proofs.

The dictionary may be cordially recommended for purposes of technical translation from English into any of the other six languages, but it does not serve for translation into English. To this extent it is less useful than the Deinhardt and Schlomann series of illustrated six-language technical dictionaries, which contain complete indexes, although they do not comprise Portuguese.

A Modern Platonist.

Matter, Life and Value. By C. E. M. Joad. Pp. xviii + 416. (London: Oxford University Press, 1929.) 18*s*. net.

THIS book, which is Mr. Joad's philosophical confession of faith, is an interesting and very readable work. The author is opposed to the tendency prevalent among philosophers of reducing the number of real independent entities in the universe in the supposed interests of logical consistency. Mr. Joad argues forcibly against various types of monistic philosophy, and for himself is prepared to admit the existence of the three types of entity mentioned in the title and to base his system of philosophy on this division in spite of any logical difficulties that may arise.

The style of writing is always lucid and pleasant and sometimes eloquent. The views of others are well and fairly discussed. The author's own views are stated modestly without trying to disguise the difficulties involved or pretending that only a fool could think otherwise. Along with these qualities the book has marked defects which appear to be the result of carelessness and haste. Many books on scientific subjects are of necessity written in a hurry because their interest is ephemeral, but a philosophical work, if it is worth reading at all, is equally worth reading in ten years' time and is none the worse for a little care and deliberation. The intervention of an editor armed with a large blue pencil might have worked wonders. Among other things, he would have eliminated the first chapter or had it rewritten. This chapter professes to give a criticism of classical scientific materialism and to state the scientific evidence in favour of admitting life as an autonomous principle or activity distinct from matter. It is quite the worst thing in the book and is likely, standing where it does, to prejudice the reader against the rest of the book. The author apologises for his first chapter, it is true, but it is not apologies that are needed. The defects are not

fundamental; that is to say, the author has an intelligible view to put forward; they are chiefly a matter of looseness and carelessness of expression. The most glaring error, though in its context it is trivial, is the statement that ". . . the principle of entropy was not known to nineteenth-century physics" (pp. 9-10).

Another example of careless expression is seen later on where the question of 'values' is being discussed. The author in stating his æsthetic theory deals primarily with the subject of music—an interesting and, to the reviewer at least, an illuminating discussion. Having explained that music is not properly concerned to represent or symbolise either objects of the physical world or human activities or relations, and that it is therefore in a quite definite sense meaningless, he then produces the startling definition that music which produces its proper and intrinsic effect is to be called 'significant music' (p. 285). The definition is harmless if the reader keeps in mind that the word 'significant' does not mean significant, in fact does not mean anything; but it is very careless. The reason for the use of this unsuitable word appears to be that Mr. Joad has been bemused by that catchword of the second-rate art critics, 'significant form' (pp. 299-304). Lastly, the book as a whole is too long for the amount of matter it contains, and many passages are rambling and diffuse.

Mr. Joad is a Platonist, as many English philosophers have been. He is generally at his best when he is most purely Platonic; his ideas then are clear and firmly developed. But when he draws on the theories of modern thinkers—and he does this in a curiously promiscuous way from Schopenhauer, Bergson, Whitehead, and Bernard Shaw—the reader gets the impression of confusing eddies and cross currents breaking up a smooth current of thought. It is as though he cannot bear to let go any philosophical idea that appeals to him, but must add it to his collection, however incongruous it may be.

A. D. R.

Our Bookshelf.

A School Certificate Chemistry. By G. H. J. Adlam. Pp. x+334. (London: John Murray, 1929.) 4*s*. 6*d*. net.

DURING the last few decades much attention has been given to the methods of teaching science, especially chemistry. Definite courses of instruction have been framed for educational purposes, and they have tended to become stereotyped in conformity with the requirements of examining bodies. The subject matter of the science, however, has not received a similar careful scrutiny, and, whilst in the outside world epoch-making advances have been made, they have passed unheeded in the classroom. There is thus a danger that a distinction may soon be drawn between chemistry and 'schoolmaster's chemistry'. It is with this in mind, evidently, that Mr. Adlam has written his volume for elementary students, in which recent industrial methods receive preference over the obsolescent, uneconomic preparations of the average elementary text-book.

Mr. Adlam sees no reason why the newer, large-scale methods of producing inorganic substances should not be adapted for teaching purposes. Thus, the steaming of red-hot iron is preferred to the action of zinc on sulphuric acid for preparing hydrogen. For lecture purposes this is excellent, but for a class of young students it is impracticable. Oxygen is prepared (p. 18) from sodium peroxide and water, whereas the usual laboratory method, by decomposing a mixture of potassium chlorate and manganese dioxide, is only mentioned incidentally, emphasis being placed upon the fact that it affords a good example of catalytic action. Again, the synthesis of ammonia from nitrogen and hydrogen (from water gas) is simple enough in theory to take its place beside the decomposition of ammonium salts with lime. Nitric oxide and nitrogen peroxide are now made synthetically as intermediates in the manufacture of nitric acid, so that the complicated reactions of nitric acid with various metals are only given a subsidiary place in Mr. Adlam's book.

From a perusal of this work, it is readily apparent that the author has endeavoured to turn to account for teaching purposes the modern large-scale methods for the manufacture of common chemicals. The traditional laboratory methods, which are also included, are relegated to the background.

In African Game Tracks: Wanderings with a Rifle through Eastern Africa. By F. L. Puxley. Pp. 320+8 plates. (London: H. F. and G. Witherby, 1929.) 12*s*. 6*d*. net.

ONE is frequently being reminded that the reading public cares little for precision of detail. So long as it seems interesting and the author's style makes for easy reading, any book on African sport or travel has apparently a successful life, while one dealing with actual fact and truly related incident is a slow seller. The book under notice is probably to be placed in the former category. Its author has had a long and varied experience in many spheres of African life since 1896, mainly, as he says in his foreword, in regions lying between the Sudan and the Cape, but from what he says about "Sese Island" in Lake Victoria and the sitatunga, which he spells sitatungu, he writes of one place at least which he has not visited. The islands of the Sese group are for the most part fairly high and wooded, not surrounded with wide and deep papyrus swamps, as he states, nor are they suited to the sitatunga, which inhabits a small island much farther out in the lake.

The first half of the book deals with incidents, things, and people belonging to South African his-

tory, about which much has been written, but it is nevertheless all interesting reading. The chapter on whaling off the Durban coast is especially so, for little has appeared in print on the subject, probably for the reason that when the animal has been sighted, chased, and harpooned, the excitement changes to butchery and malodorous operations. The information given on tsetse flies, sleeping sickness, and kindred subjects reads like knowledge of long ago, but in spite of its inaccuracy of detail, the book, with its wealth of hunting incident and descriptions of bush life, is a very readable one.

Physics of the Air. By Dr. W. J. Humphreys. Second edition, revised and enlarged. Pp. xii + 654. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 30*s.* net.

THE first edition of "The Physics of the Air" was reviewed at length by Sir Napier Shaw in NATURE of Mar. 17, 1921. Prof. Humphreys has taken advantage of the opportunity offered by a second edition to meet some of the criticisms levelled at the first. A great deal of recent work has been incorporated, and what is even more important, numerous references have been added as footnotes to serve as guides to further reading. The book seems smaller than its predecessor, but that is an illusion, for the decrease in size has been brought about by cutting down the over-generous margins of the first edition. The amount of text has actually been considerably increased, while the volume is certainly handier. None of the original matter has been deleted, though much of it has been rewritten in the light of the latest investigations.

One of Sir Napier Shaw's criticisms concerned the omission of the important subject of meteorological acoustics. That has now been remedied in a section of 33 pages containing two chapters, the first dealing with effects of meteorological conditions on sound transmission, and the second with sounds of meteorological origin, such as thunder and the howling of the wind. The reflection and refraction of sound are discussed mathematically on similar lines to the reflection and refraction of light rays, leading, for example, to the theory of 'acoustical mirage', which is examined in detail. On the other hand, the remarkable phenomena of the 'zone of silence', beyond which sounds may be heard to abnormal distances, are dismissed very briefly, and no actual examples are quoted.

The new edition of Prof. Humphreys' work should be in the possession of every meteorologist, and of other men of science whose work deals in any way with the domain of the atmosphere.

Penrose's Annual: the Year's Progress in the Graphic Arts. Edited by William Gamble. Vol. 32. Pp. xvi + 168 + 70 + 80 plates. (London: Percy Lund, Humphries and Co., Ltd., 1930.) 8*s.* net.

THE general impression on looking through this volume is that it shows a larger proportion of examples of work in colour, and that of a rather superior quality, when compared with the annuals of the last few years. Of course it is impossible to say more than this, and to judge more precisely of the success of the colour imitation, unless the original and the copy are seen side by side.

We have the editor's dictum that though the past year has not been notable for any striking new developments in printing or process methods, there has been quiet and steady progress in almost every branch of the graphic arts. Perhaps the greatest advance has been in the method of the chromium plating of printing surfaces. It has been found that the current density may be reduced to about a third of what was considered necessary, and that the best deposit is obtained at 68°-70° F.

The effect of colour in advertising is shown in some very interesting results; for example, where the only variant was the tint of the paper used in a circular, for every hundred orders resulting from white paper, blue produced 120, buff 130, green 150, pink 180, but it must not be supposed that pink paper would always be the most advantageous. Scientifically considered, the most interesting of the numerous examples is a four-colour reproduction of colour photographs on Agfa plates of four pathological human eyes taken by Dr. L. D. Redway of New York City by means of a special apparatus devised by him, the exposure in each case being one-fiftieth of a second.

Photographic Emulsions: their Preparation and Coating on Glass, Celluloid and Paper, Experimentally and on the Large Scale. By E. J. Wall. Pp. viii + 256. (London: Chapman and Hall, Ltd., 1929.) 21*s.* net.

MR. WALL was specially fitted to write and compile such a work as this because of his varied experience as a manufacturer and as a teacher, his enthusiastic study of the subject, and his excellent memory. An index would have added to the convenience of consulting the book, though the detailed table of contents somewhat makes up for this deficiency. The book is full of the descriptions of practical methods of formulæ old and new, though formulæ that are obviously obsolete are not given.

The subject is treated in a thoroughly practical manner; the book does not pretend to give theories, though the reasons for the procedure described are given, and also the unfortunate results of the omission of proper precautions. The author says that "as a field for experiment emulsion making is extremely fascinating. As a means of spending money it is only equalled by dabbling in stocks". The information is based on many years of practical experience, but Mr. Wall acknowledges that there are little points which can only be learnt by continued experiment. If the subject is to be attacked seriously, the mere coating and exposure of a few plates and bits of paper will lead nowhere. Accurate photometric testing methods must be used, and the various factors varied one at a time, and it is utterly hopeless to expect good results by working in a dark room that has been used for the ordinary operations of

developing, fixing, etc., because it is impossible to keep such an apartment scrupulously clean. The information given must be regarded as sign-posts, indicating the way, rather than as milestones giving definite certainties.

Textile Microscopy. By L. G. Lawrie. Pp. 144. (London: Ernest Benn, Ltd., 1928.) 25*s.* net.

THE technique employed in the microscopical examination of textile fibres forms the subject of this book, not the appearance and characters of the fibres, as the title might imply. Special methods applicable to the microscopical examination of textiles are in fact found only in the last 45 pages, the first 86 pages being devoted to a description of the microscope and its optical principles and of other apparatus, with an occasional reference to the special subject.

This first part gives a full though simple account of the microscope and its use, such as would serve as an introduction to any branch of microscopy. These pages, on the whole, are good, but the author is not always so careful in his statements as he might be. For example, alluding to the use of the draw-tube for increasing magnification, the fact that objectives are corrected for a particular tube-length is not mentioned, and though true for critical work, it is an exaggeration to say that the Abbe condenser is "quite unsuitable for high-power work" or that the lack of perfect centration of a nosepiece "causes considerable inconvenience" with high powers.

In the second part of the book a great deal of information is given on the reactions, staining and others, of textile fibres, that it would be difficult to find except in scattered papers. The pages on the microscope and apparatus are profusely illustrated, the large page and glazed paper ensuring excellent reproductions, and three plates of photomicrographs of textile fibres are included. These last named features may account for the seemingly high price of the book.

Climate: a Handbook for Business Men, Students and Travellers. By Dr. C. E. P. Brooks. Pp. 199. (London: Ernest Benn, Ltd., 1929.) 10*s.* 6*d.* net.

IN view of the importance of a knowledge of climate in numerous activities and in many lines of research, it is remarkable how few authoritative volumes exist on the subject. For this reason Dr. Brooks's volume will be welcome, although we could wish that it had been a little fuller. To cover the climates of the world in two hundred pages, of which several are filled with statistical matter, is summary treatment. But Dr. Brooks wastes no words and manages to compress a great deal into a small space. In order to economise space, he plunges direct into the description of climates based on geographical distribution. He omits all preliminary discussions of physical processes and general meteorological considerations. But this does not mean that the treatment is solely descriptive.

Lucid explanations are given in places, sparingly perhaps for the student, but no doubt often enough for the other categories of readers for whom the book is intended. Under each climatic area, meteorological data are given for selected stations, temperature and rainfall for every month of the year, daily range in January and July, extremes, relative humidity for January and July, cloud amount and number of days with rain, snow, and thunder. There are only three diagrams. A few bibliographical references are given for each part of the world.

The Growth of the World and of its Inhabitants. By Prof. H. W. Swinnerton. Pp. 211. (London: Constable and Co., Ltd., 1929.) 5*s.* net.

As a sardine might be shy about biting a whale, one feels diffident at the very idea of criticising Prof. Swinnerton. Yet he makes the author of "Principles" and "Elements of Geology" sole father of that science. Surely Sir Charles Lyell would rather have given Hutton credit for the geology of fire, and Werner for the geology of water; and Hutton would have referred to his master, Black, whose theory of latent heat was the first clue to the story of the rocks.

Again, it is disconcerting to find the theory of land bridges still held in equal esteem with that of continental drift. Some of us took the trouble to visit countries like Greenland, on the so-called North Atlantic bridge. We picked harebells there, and were quite prepared for Suess with his Atlantic rift. It was Greenland which opened Wegener's eyes to the land bridge theory as a superstition; but here it haunts Prof. Swinnerton like a belated ghost.

To do Prof. Swinnerton justice, rarely does he venture into fields of controversy. So far from looking for trouble, he is painfully cautious. He is very lucid, always trying to use simple words, only occasionally blundering into the Græco-Latin jargon which chokes the general reader and so limits the sales of scientific books. Until a Homer or a Shakespeare comes to write these glorious themes, we should be well content with books like this one, sincere, cautious, accurate, written by men of broad views and profound scholarship.

An Introduction to Geography. By Prof. H. J. Fleure. (Benn's Sixpenny Library, No. 91.) Pp. 80. (London: Ernest Benn, Ltd., 1929.) 6*d.*

PROF. FLEURE defines with swift ease the fields of geographic research, and uses each as setting for one or two examples, gems of exposition. There is more in this brief pamphlet than in many a stately book, but finest of all is the description of that oceanic climate wherein the chemistry of heat and moisture creates the humid brown earths in which the beech tree grows, the area of mixed farming and of parliamentary government in nation States, bordered by a broad margin of dictatorships. Human affairs in terms of natural law are almost a new field of research.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Action of Low Velocity Electrons on Micro-Organisms.

THAT ultra-violet light has a definite lethal action on certain micro-organisms is well known. The nature of this lethal action is being studied extensively, but hitherto (so far as is known) no work has been done to determine the action of low velocity electrons of known energy on micro-organisms. Since electrons and radiant energy seem to be so closely related, it was considered worth while starting a series of experiments in this field. It is the purpose of this note to present an outline of the results obtained to date.

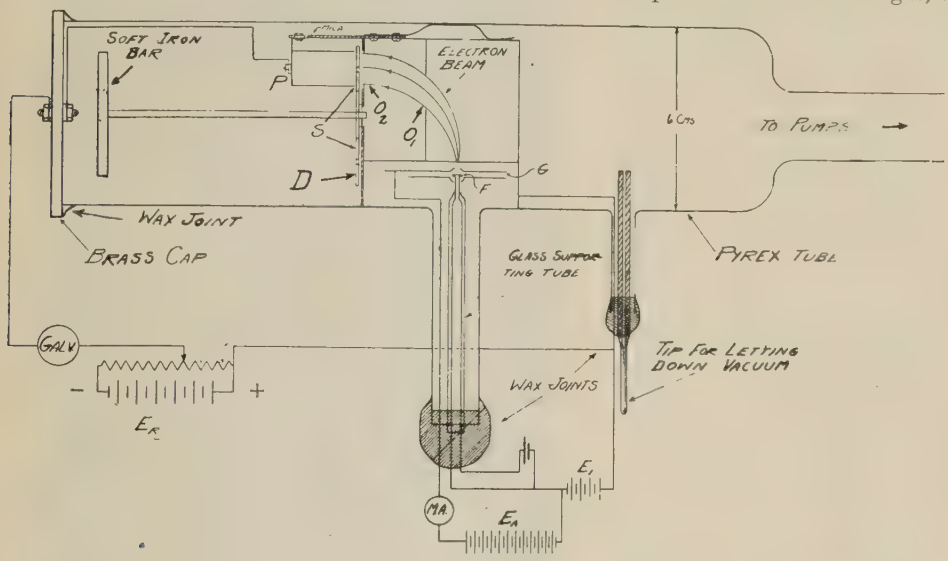

FIG. 1.

Apparatus and Experimental Method.—Fig. 1 shows the apparatus used, together with a diagram of connexions. Electrons from the oxide-coated filament F are accelerated to the metal plate G by a potential E_A of about 90 volts. Those passing through the opening in G are retarded in passing to the next baffle and enter C with an energy per unit charge equal, very approximately, to E_1. Thus by varying E_1, electrons of any desired energy can be made to enter C. After entering C, the beam, deflected in a circular path by a magnetic field, passes through the circular openings O_1 and O_2, striking the platinum slide S, on which there is a thin smear of the organism to be bombarded. The beam is deflected in a circular path for the purpose of eliminating soft X-radiation produced in the vicinity of the filament which preliminary experiments showed is intense enough to kill the organisms. The Faraday pail, P, mounted as shown, served to determine the number of electrons striking unit area of the bombarded portion and also to determine the energy distribution of the beam.

Distribution curves were taken with each exposure. These curves showed very good homogeneity of the beam; the curves in each case falling from maximum to minimum within a range of 1·5 volts or less. The vacuum throughout the work was maintained at a pressure of approximately 5×10^{-6} mm. Four exposures were made without breaking the vacuum by mounting four slides on the face of the disc D, which was turned with a magnet.

Staphylococcus albus was chosen as the organism with which to work. A light smear of this organism in beef broth solution was placed on the platinum slides S. This, when dry, was placed in the apparatus, and the area (a circle of approximately 0·8 sq. cm. in diameter) in front of the opening O_2, Fig. 1, was bombarded for a definite length of time with electrons of known energy. The slides were then removed from the vacuum and, after being carefully covered with strips of moist solidified agar, were incubated.

Results.—A series of eighteen exposures with electronic energies ranging from 19·5 volts to 30 volts have been made. In every case exposures in the range of 19·5 volts to 25 volts showed little or no killing, while exposures at higher electronic energies showed definite killing, the total energy falling on unit area of the bombarded surface in each case being constant at 13×10^7 ergs. The photographs reproduced as Fig. 2 show four typical exposures made with electronic energies of 25, 27·5, 29, and 30 volts. The photograph taken at 30 volts shows almost complete

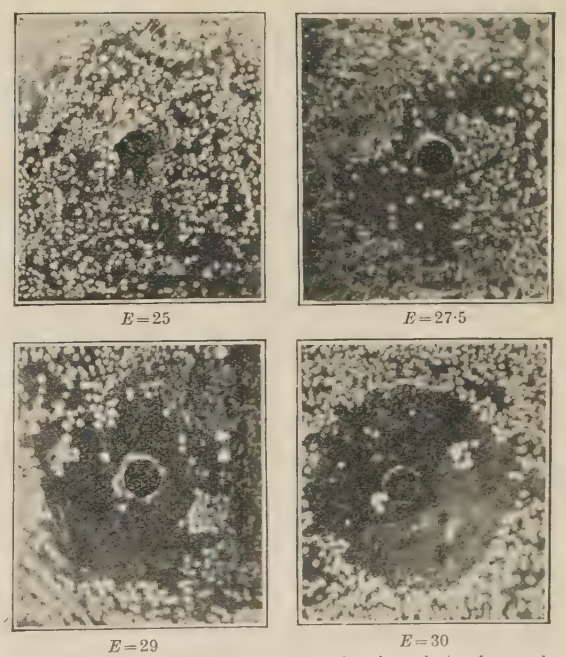

FIG. 2.—Photographs showing the action of various electronic energies E. Total energy per unit area of bombarded surface in each case was approximately equal to 13 joules.

killing over the circular area bombarded. Another series of exposures at 30 volts with various values of total energy showed definitely that the lethal action is a function of the total energy per unit area of the bombarded surface. Whether the organisms would be killed at the lower voltages by greatly increasing the total energy remains to be shown by further experiments.

Summary of Results.—The results of this work indicate that: (1) *Staphylococcus albus* can be subjected to a vacuum of 5×10^{-6} mm. of mercury for so long as eight hours without showing signs of killing; (2) it may be killed by the action of low velocity electrons; (3) under the conditions of this experiment, the lethal action is a function of the energy of the individual electrons; (4) the per cent killed at constant electronic energy is a function of the total energy of exposure.

I wish to express my thanks to Prof. G. Sperti for suggesting the problem; to Dr. George Burger for valuable assistance with the bacteriological phase of the problem; and to the Basic Science Research Laboratory, University of Cincinnati, for making the work possible.

D. A. WELLS.

University of Cincinnati.

Spiral Forms in Gas Discharges.

THE spiral forms of the high frequency electrodeless discharges observed in organic vapours by Ghosh and Chatterjee (NATURE, Oct. 26, 1929), and in iodine vapour by MacKinnon and Robertson (NATURE, July 13, 1929), appear to be very similar to the forms of discharge observed by us under certain conditions in argon which was very slightly impure. A very brief account was given by W. T. Perry (Note: B.Sc. Thesis, Oxford, 1928), but as this account is somewhat inaccessible, it may be of interest to describe some of the properties of these discharges. Recently, P. Johnson has observed the same type of discharge under similar conditions in neon.

The conditions under which these discharges occur appear to be the following. They occur in neon and argon only when the gas is very slightly impure, and especially when the trace of impurity is a metallic vapour. In carefully purified inert gases we have never observed any striations other than the types described by us in NATURE (Jan. 12, 1929). The pressure of the gas must be fairly high and the current flowing through the tube must be large—of the order of 20 milliamperes. They occur, with continuous wave oscillations, at all the wave-lengths we have tried from 11 metres to 320 metres; in tubes from 0·5 to 4 cm. in diameter, and at pressures from 2 mm. to 20 mm. of mercury.

Some idea of the structure of these discharges may be gathered from a study of the photographs reproduced in Fig. 1 A, B, C, D, which show typical forms the discharge may assume in a tube 3 cm. in diameter containing argon at a pressure of 7 mm. of mercury. The oscillatory potential of a frequency corresponding to 11 metres was applied by two external wire electrodes wrapped round the tube about 10 cm. apart, and the changes were produced by altering the potential between the electrodes.

With small currents there is a diffuse general luminosity filling the whole tube between the electrodes and some distance beyond them. As the current is increased there is a sudden change to the form of Fig. 1 A, where the luminosity is wholly confined to the line of luminous spheres. The size of the spheres seems to be almost independent of the diameter of the tube and inversely proportional to the pressure of the gas. Unlike the striations in the positive column, they are little affected by a strong magnet.

Further increase in current imparts a motion to the line of spheres which begins to move toward one electrode and around the axis, giving the line a helical form, and generally other lines of discharge appear (Fig. 1 B and C).

With larger currents more lines of discharge appear, the luminosity being entirely on the outside, the axial region being comparatively dark. The pattern is then very symmetrical, the lines of the discharge at high pressures being very close together and comprising ten or more parallel helices (Fig. 1 D). If this discharge be viewed with a spectroscope, the lines of

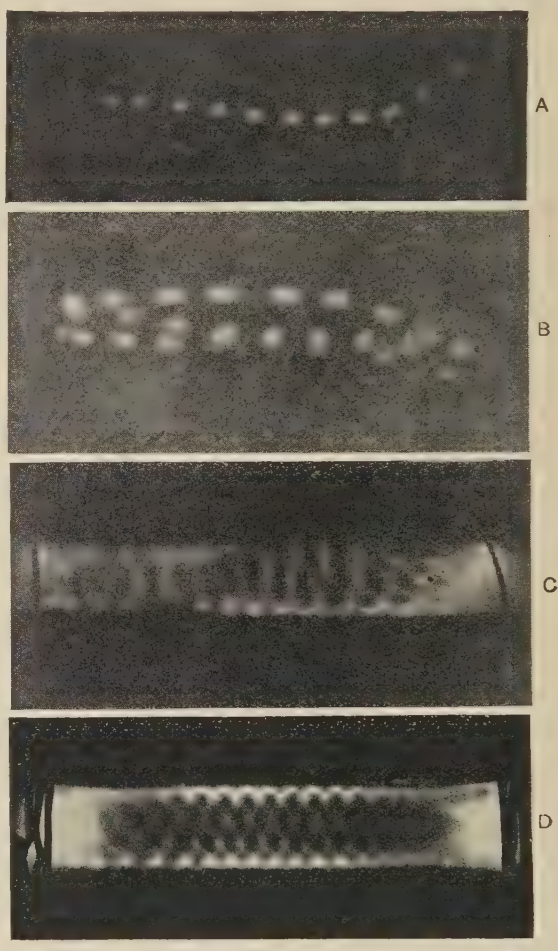

FIG. 1.

impurity appear to have become more prominent, in comparison with the argon lines, and sometimes the discharge is coloured with momentary flashes of light characteristic of them.

This type of discharge has not been observed by us in hydrogen, nitrogen, or air, possibly because it is difficult to maintain a discharge in these gases at a pressure greater than one millimetre of mercury with continuous waves. It would be interesting to know the conditions of wave-length, pressure, and current in the experiments of Messrs. Ghosh and Chatterjee.

What precisely is the mechanism of these discharges is very difficult to determine. It seems probable that the form is in some way connected with the distribution of the more easily ionised impurities which would be expelled by the space charge to the outer parts of the tube. The discharge takes two or three seconds

usually to settle down to a definite form, and this would support such a suggestion.

Note.—Spiral forms of discharge in ordinary vacuum tubes using direct currents appear among the many observed by de la Rue and Muller so early as 1877 (*Phil. Trans.*). They also noted the prominence of the mercury lines in such a discharge. Gassiot (*Phil. Trans.*, 1858) also makes mention of a spiral discharge.

S. P. McCALLUM.
W. T. PERRY.

Electrical Laboratory,
Oxford.

Mode of Feeding of the Bopyridæ.

IN connexion with a study which I am about to publish on the effects of one of the Bopyrid isopods, *Gyge branchialis*, on its host, *Upogebia littoralis*, I have become interested in certain questions concerned with the mode of feeding of the Bopyridæ which seem to have been neglected by students of these animals and to which I wish to direct attention.

It may be recalled that the Bopyridæ are parasitic in the branchial cavity of decapod crustaceans, and that they normally occur in pairs, a large female individual and a minute and less highly modified male, which leads a sedentary existence on the body of the female. The latter, at any rate, obviously feeds by sucking the juices of the host by means of its piercing and suctorial mouth-parts, but from what part it sucks them appears, if one looks critically into the literature, to be by no means clear. The animals are often spoken of as though they suck the juices directly from the thorax of the host. Such an eminent authority as Bonnier, in his monograph on the Bopyrids (*Travaux de la Station Zoologique de Wimereux*, tome 8; 1900), seems clearly to imply this, for he speaks definitely (p. 50) of the animal sucking "les liquides viscéraux", and again (p. 104), "les liquides de la cavité viscérale de l'hôte". Yet when one reflects that the ventral surface of the parasite, on which the mouth-parts open, is turned towards the branchiostegite of the host and away from the latter's body, these statements appear difficult to accept literally. It would seem that the only way in which the animal could suck "the liquids of the visceral cavity of the host" would be for it to protrude its mouth-parts for a relatively great distance, and at the same time to twist them round to an extraordinary extent, so as to drive them into the host's body, from which they are normally turned *away*. The conformation of the mouth-parts does not suggest that such a proceeding is possible.

The only alternative seems to be to suppose that the animal sucks the juices from the inner membrane of the branchiostegite. So far as I know, however, this is nowhere definitely suggested in the literature, though Dr. Calman, to whom I have appealed, tells me that he has always supposed that this is what happens. The membrane is certainly often quite well vascularised, though sometimes, as in the *Upogebia* upon which I have been working, it is so thin that one would not suppose it to be a very satisfactory source of nourishment for a suctorial parasite. It appears to me that, unless I have overlooked some important contribution to the subject, no one has really demonstrated clearly and definitely from what part of the host the parasite does extract its food, a curious omission in a group of animals which have received a very fair amount of attention.

This is not all: there are difficulties also in connexion with the male. The larval form which first invades the branchial cavity of the host develops into the large female form. Afterwards another arrives, settles down on the body of the first and becomes a male. There are two, probably related, questions concerning this second arrival to which I can find no clear answers, namely: How does it feed? What causes it to become a male? Apparently the larvæ are equipotential with regard to sex. If No. 2 did not feed at all, the difference in its subsequent development as compared with No. 1 would be accounted for. But the mouth-parts are perfectly well developed like those of the other sex, and some of Bonnier's remarks certainly seem to imply that it does feed. But neither Bonnier nor anyone else, so far as I know, explains how a minute animal leading a sedentary existence on the female's ventral surface, which is turned towards the branchiostegite of the host, contrives to reach the host's body with its mouth-parts. Hypothetical acrobatics by which it might manage to do so might be suggested, but I will not waste space on these. The point is that if it really does so, it is worth while taking the trouble to find out how.

If the male does not suck the host's juices directly, and yet does feed, the only alternative is to suppose that it sucks the juices from its own female. Should this prove to be the case it would be surprising that so interesting and remarkable a state of things should not have been noted before, but personally I do not think it is very likely. On the whole, it rather looks as though the male does not feed, but if it can be shown that it does not, other questions are raised. Is it possible that it can exist entirely without food for so long as the female, which feeds vigorously and the life span of which is apparently coincident with that of the host? Or is there a succession of males during the lifetime of one female? (I may say that I have examined many *Gyge* and never found an adult female without a male). If the male does not feed, why are its mouth-parts and gut so well-developed? Is it, speaking teleologically, so that it can start feeding and develop into a female if the original female dies? I could add other questions.

What I have said will have been sufficient to suggest that present knowledge of the biology of the Bopyrids is scarcely commensurate with the knowledge of their structure. The points I have raised ought not to be beyond the ingenuity of someone having access to living material to settle. I hope I may have an opportunity of doing something in this direction myself at some future time. But my immediate object is to inquire whether there is no zoologist who can now from experience already obtained throw some light on these questions, which seem so obvious and yet seem to be carefully avoided or slurred over in all the literature with which I am acquainted.

B. W. TUCKER.

Department of Zoology and
Comparative Anatomy,
Oxford.

Behaviour of the Mercury Line 1849·57 ($1^1S_0 - 2^1P_1$).

UTILISING an arrangement which permits working in an atmosphere of nitrogen and a Hilger quartz spectrograph model E/37 with Schumann plates (see details in *Contrib. Estd. Ciencias Fis. Mat. Serie matemáticofísica*, **4**, 102; 1927, La Plata) we have investigated the persistence of the mercury line 1849·57. In the spark spectrum, using Gramont's fulgurator with solutions of mercury salts, $Hg(CN)_2$ or $Hg(NO_3)_2$, it is only possible to register photographically the mercury line 1849·57 when working in an atmosphere of nitrogen (Fig. 1). In the arc spectrum, using McLennan's vacuum arc lamp and operating in a normal atmosphere, and in a nitrogen

atmosphere, using carbon electrodes impregnated with the same mercury salts, the experimental results are strictly the same. These facts support the objection formulated by Gerlach (*Phys. Berichte*, **10**, 429; 1929) with regard to my note published in *Comptes rendus* (**187**, 761; 1928). Operating in the conditions above described and with progressively diluted

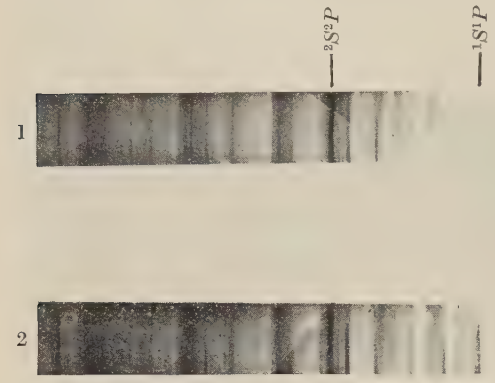

FIG. 1.—1, Spectrogram using normal atmosphere; 2, spectrogram using nitrogen atmosphere.

solutions of mercury salts, the persistence of the lines 2536·52 ($^1S^3P$) and 1942·0 ($^2S^2P$, Hg^+) is much greater, in all conditions, than that of 1849·57. The latter line is a theoretical but not an experimental 'raie ultime'; the true 'raies ultimes' of Hg are, in all conditions, 2536·52 and 1942·0. For this reason we consider that Meggers is mistaken in supposing ("Critical Tables", **5**, 323) that the line 1849·57 is the most persistent.

ADOLFO T. WILLIAMS.
Instituto de Física,
Universidad de La Plata,
R. Argentina, Nov. 12.

Scattering of Electrons by Gold.

A METHOD has been developed by Born by which the scattering of electrons by single atoms can be worked out on the wave mechanics. The method has been used to calculate the variation of elastic scattering with angle for helium, using the atomic fields worked out by Hartree, and fair agreement is obtained with the experiments of Dymond on the scattering in helium gas (NATURE, May 11, 1929, *Proc. Camb. Phil. Soc.*, **25**, p. 304).

The theoretical formula for the scattering can be put in the following form. The proportion of a beam of electrons scattered elastically per unit length of the beam, per unit solid angle, by a gas containing n atoms per unit volume, is $n\,|f(\theta)|^2$ where $f(\theta)$ is $\frac{e^2}{2mv^2}(N-F)$ $\mathrm{cosec}^2\,\theta$. N is the atomic number of the scattering atom, 2θ the angle of scattering, and F the atomic scattering factor familiar in X-ray diffraction, calculated from the Schrödinger charge distribution. F is a function of $\sin\theta/\lambda$, where λ is the de Broglie wavelength of the electrons. The corresponding formula for the scattering of X-rays by an atom is $\frac{e^2}{mc^2}F$ for plane polarised waves, in the plane perpendicular to the electric vector. The close resemblance between these two expressions can be accounted for as follows. In calculating the scattering of X-rays we assume that each element of charge $d\rho$ in the atom scatters a spherical wavelet of amplitude, $e^2d\rho/mc^2r^2$, according to the classical formula of J. J. Thomson. The total scattering is obtained by considering the interference of these wavelets. We may suppose, analogously, for de Broglie waves that each element of charge in the atom scatters a spherical wavelet of amplitude $\frac{ed\rho}{2mv^2}\mathrm{cosec}^2\,\theta$. We should expect this according to the theory of inverse square law scattering, if the element of charge were held rigidly at rest; presumably, in a collision when this is not the case, the atom is excited. The nucleus also scatters a wave of amplitude $-\frac{Ne^2}{2mv^2}\mathrm{cosec}^2\,\theta$, the negative sign meaning opposite phase. A consideration of the interference of these waves leads to the formula given above. It will be noticed that the scattering is a function of $\sin\theta/\lambda$.

G. P. Thomson has recently published a curve for gold, deduced from his experiments on the diffraction of cathode rays by thin foils. The curve in Fig. 1 gives

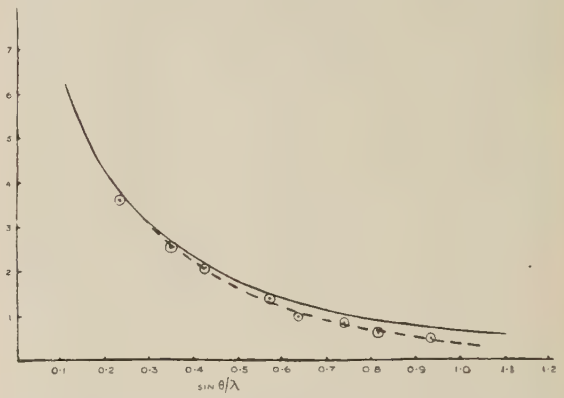

FIG. 1.—Electrons scattered by a gold atom. Number scattered per unit solid angle given by square of the ordinate. Full line, calculated curve; dotted line, curve corrected for heat motion in the crystal; circles, experimental readings, from G. P. Thomson's paper.

the relative scattering for varying $\sin\theta/\lambda$, for 30,000 volt electrons. The full line in the figure is $(N-F)\,\lambda^2/\sin^2\theta$ in arbitrary units, plotted against $\sin\theta/\lambda$; the dotted line is the same, corrected for heat motion in the crystal. The encircled points are the experimental points fitted to the dotted curve at $\sin\theta/\lambda = 0{\cdot}32$. The F curve was calculated from the atomic field of Thomas, which for heavy atoms has been found sufficiently accurate in the X-ray case.

N. F. MOTT.
Physics Laboratories,
University of Manchester.

A Theory of Tracheal Respiration in Insects.

IT has been shown by Krogh (*Arch. f. Ges. Physiol.*, vol. 179; 1920) that the laws of diffusion of gases will explain the supply to the tissues of insects of those quantities of oxygen which they actually consume. This theory is satisfactory so far as it goes, but it makes no provision for such increased demands for oxygen as must arise locally in active tissues. It is the purpose of this letter to outline a theory, complementary to that of Krogh, which will satisfy these requirements, and to indicate the experimental evidence by which this theory is supported.

If it be assumed that the terminal portions of the tracheal tubes are bounded by a membrane which is semipermeable with respect to lactic acid and similar metabolites, then, during normal conditions of rest, liquid will be drawn from the tissues up the tracheal tube by capillarity until its progress is arrested by the osmotic pressure of the tissue fluids. During increased activity of the tissues, lactic acid will be

produced, and the osmotic pressure will rise. Hence liquid will be absorbed from the tube, and the column of air will extend more deeply into the tissues. Moreover, this change will take place first in those regions where the need for oxygen is greatest.

This theory is based chiefly upon experiments with the larva of the mosquito, a detailed account of which will be published shortly. Briefly, it has been found: (i) That in the resting condition the terminal portions of the tracheal tubes are filled with liquid; (ii) that during asphyxiation this liquid is absorbed, and the column of air extends rapidly towards the actively contracting muscles—more slowly and much later towards inactive tissues (for example, the rectal gills); (iii) that on readmission of air the level of liquid slowly rises to its original level; (iv) that during asphyxiation an excess of lactic acid is present in the tissue fluids; (v) that hypertonic solutions of sodium chloride and of sodium lactate introduced into the living larva cause a similar extension of air down the tracheal tubes; (vi) that hypotonic fluids (distilled water) are without effect, or cause a slight rise of the liquid in the tracheæ.

It is clear that the mechanism described will serve as a 'fine adjustment' for tracheal respiration in insects, just as changes in the capillary bed serve as a 'fine adjustment' for the internal respiration of vertebrates.

V. B. WIGGLESWORTH.

London School of Hygiene and
Tropical Medicine, Dec. 5.

Chemical Biogenesis and the Development of Secretion Cells.

DR. LEEMANN'S interesting letter (NATURE, Dec. 21, p. 946) emphasises once more the gains which are bound to accrue from an increasing correlation between organic chemistry, biochemistry, and certain branches of purely biological science. As one who was privileged to obtain a first-hand acquaintance with the classical phyto-chemical researches of R. T. Baker and H. G. Smith on the Australian flora, I am of opinion that such correlation is often realised most effectively by active collaboration between investigators in the related fields. Thus, it may be justly asserted that collaboration between the histologist and the organic chemist has now become desirable in attacking the engrossing problem of chemical biogenesis (that is, chemical origin *in vivo*) in the terpene series. Nevertheless, one would hesitate to endorse Dr. Leemann's sweeping dictum that the study of such problems "should *only* [my italics] be done in close connexion with cytology and cell development". The purely organic chemical aspect of the subject must not be dismissed too lightly. At the present day, after researches extending over half a century, the study *in vitro* even of such familiar and fundamentally important substances as menthol and menthone is regrettably incomplete. Moreover, of how many essential oils can it be claimed that our formal chemical knowledge is full and adequate?

There is little doubt that a knowledge of the precise cytological origin of the terpenes would be a valuable aid in deciding whether they are derived from carbohydrates (cf. Stewart, "Recent Advances in Organic Chemistry", 1927, vol. 2, pp. 240 and 266), or from protoplasm via amino-acids. Dr. Leemann's suggestion that they originate from protoplasm, rather than from the cell wall, appears to accord with the histological occurrence of fixed oils; while from the chemical point of view leucine offers an attractive approach to the fundamental structural unit (*iso*pentane nucleus) of terpene molecules.

JOHN READ.

The University, St. Andrews.

Hydrolytic Adsorption at Colloid Surfaces.

THE outstanding work on hydrolytic adsorption has been carried out with purified charcoal (see, for example, Bartell and Miller, *J. Am. Chem. Soc.*, **44**, 1866; 1922: **45**, 1106; 1923), and definite positive results have been obtained. The measure of the hydrolytic effect in the case of the numerous negative hydrophobic (acidoid) sols, such as colloidal mastic, platinum, gold, arsenious sulphide, etc.—all of which are remarkably alike in structure and in reactions—is complicated by the well-established phenomenon of catalytic interchange. For example, in the presence of salts, such as barium chloride, the hydrogen ion at the colloid surface suffers an interchange with the added barium ion, and the corresponding increase in acidity is superimposed upon any change in acidity due to the hydrolytic action at the surface. It has become the general practice to ascribe the whole of the increase in acidity of acidoid sols (on the addition of neutral salts) solely to the cationic replacement, and to neglect any probable hydrolytic effect. That the latter effect is real is evident from the following consideration.

Colloidal platinum has a great affinity for bases, particularly bases of higher valence such as barium hydroxide, and no measurable affinity for the common inorganic acids such as hydrochloric acid (*J.C.S.* 551; 1928: 618, 623; 1929). This action I have ascribed to the acidic nature of the oxidised platinum which constitutes the greater part of the colloidal platinum surface. It follows from obvious chemical principles, that when a salt such as barium chloride is added to a platinum sol, the barium hydroxide must distribute itself between the hydrochloric acid and the 'acid' surface of the colloid, or in the usual terminology, barium hydroxide must be hydrolytically adsorbed by the platinum. The hydrochloric acid is, of course, a very strong acid, but the affinity of the platinum surface for barium hydroxide has also been shown to be very great. Work recently carried out by me, and to be published in due course, shows clearly that in the case of colloidal platinum (1) such a distribution does take place, (2) its effect is not negligible when compared with the cationic interchange, and (3) it plays an important part in coagulation and reversal phenomena. The same conclusions will probably apply, in varying degree, to the other acidoid sols.

S. W. PENNYCUICK.

Adelaide, South Australia,
Nov. 5.

The "Encyclopædia Britannica".

As a contributor to the new edition of the "Encyclopædia Britannica", may I beg the hospitality of the columns of NATURE in order to disclaim responsibility for certain statements that appear in one of the articles over my initials? In the article "Acanthocephala" the short passage commencing with the words "the larva of *Echinorhynchus gigas* . . ." and ending at ". . . found in the seal" is not mine.

I should like to add that the editor of the "Encyclopædia", with whom I have been in communication, has expressed his sincere regret at the unfortunate interpolation, which appears to have occurred in some way during the final making-up of the page, and has undertaken to delete it in future printings of the edition.

H. A. BAYLIS.

British Museum (Natural History),
Cromwell Road, London, S.W.7,
Dec. 17.

Past Climates.

By Dr. G. C. SIMPSON, C.B., F.R.S.

THERE are only three factors which can affect the climatic zones of the world: (*a*) the amount of solar radiation; (*b*) the horizontal transfer of heat from one part of the earth to another; and (*c*) the characteristics of terrestrial radiation. If we examine each of these factors, we find that terrestrial radiation is not affected by the amount of carbon dioxide in the atmosphere, and, while dust might affect it, there is no real evidence that changes in climate are correlated with volcanic activity. The horizontal transfer of heat could only be affected by changes in oceanic currents due to a redistribution of land and water; but a comparison of the temperature of corresponding zones in the northern and southern hemispheres shows that a climatic zone is little affected by the amount of land and sea which it contains. Small changes in solar radiation may produce appreciable effects on the climate, and a theoretical investigation shows that an increase in solar radiation is accompanied by:

(*a*) an increase in temperature in all parts of the world;

(*b*) an increase in the temperature difference between the equator and the poles, and probably an increase in all other temperature differences which now exist;

(*c*) an increase in the general circulation of the atmosphere, that is, a general strengthening of the trade winds, the monsoons, cyclonic storms, and winds in general;

(*d*) an increase in the cloud amount and a consequent increase in all forms of precipitation.

THE LATE PALÆOZOIC GLACIATION.

The geological evidence is quite conclusive that during Upper Carboniferous or early Permian times, great ice action took place in many localities, especially in the southern hemisphere. South America, Africa, India, and Australia all exhibit unmistakable evidence of ice action which is far too extensive to be mere Alpine glaciation. In India especially, the evidence is conclusive that the ice sheet extended to sea-level. I think all geologists are agreed that at this period extensive ice sheets occurred within the present tropics in South America, Africa, and India, and at one place at least on the present equator.

Let us assume for a moment that we may accept this evidence at its face value and see what it would mean. Ice at numerous places in a zone of latitude indicates a mean annual temperature characteristic at present of polar regions. Thus at the time in question the present tropical zone had the conditions of the present frigid zone, and this could not possibly be brought about by any rearrangement of land and water.

If the change in climate was not the consequence of a redistribution of land and water, was it due to a radical change in solar radiation? Let us assume that the solar radiation decreased until the mean temperature of the equatorial zone was 0° C., which is approximately the present temperature of latitude 60°. I have already shown that the zonal temperature must decrease in all circumstances from the equator to the poles, hence every other zone of the earth must have had then a mean temperature below 0° C., which simply means that every part of the earth's surface would have been subject to conditions now met with only in polar regions. The glacial conditions of the equator would extend over both hemispheres with increasing severity right to the poles. These conditions could not have occurred without a total obliteration of the organic life which was already highly developed in Carboniferous times. A change in solar radiation does not therefore afford a solution of the problem.

I have noticed a tendency amongst geologists in discussing the climate of this period to assume that the climatic conditions could be very different in the two hemispheres. A picture is drawn of a great continent in the southern hemisphere, highly glaciated and sending out glaciers and ice sheets right across the equator into the northern hemisphere; while at the same time farther north there were lands covered by the luxuriant vegetation typical of the Carboniferous period.

Not only does this picture violate our conclusion that the climatic zones in the two hemispheres are always similar, but also it gives an inverted temperature gradient with the temperature rising from the ice-bound tropics to the region of rank vegetation in higher northern latitudes. To me, at least, an ice-bound tropics with rank vegetation in higher latitudes is a physical impossibility, and I can see no explanation of such a situation along meteorological lines. If, as I am prepared to admit, there was at one time ice in the present tropical zone and simultaneously sub-tropical vegetation in the present temperate zone, then I am forced to conclude that Wegener is right and there has been a considerable shift of the continents relative to the pole and the climatic zones.

THE PLEISTOCENE ICE AGE.

I will now turn to a changed climate of a more recent date, namely, that of the last great Ice Age. I do not propose to discuss the extent of surface affected by this Ice Age or the low latitude to which the ice extended. Personally, I am convinced that Wegener is right in displacing the north pole and shifting the North American continent nearer to Europe; only by some such means can the excentric position of the glaciated region with reference to the present position of the pole be explained.

However, let that be as it may, there is another

[1] Abridged from the Alexander Pedler Lecture of the British Science Guild, delivered before the Literary and Philosophical Society of Manchester on Nov. 26.

feature of the Ice Age which is of much more interest to a meteorologist: that is the occurrence of several interglacial periods during the period covered by the Ice Age. In these periods there is good evidence that, even if the ice did not entirely disappear, there was a great contraction in the ice-covered area and that temperature conditions in some of the interglacial periods were as mild, if not milder, than they are to-day. Now neither Wegener nor any geologist, so far as I know, has suggested that these interglacial periods were brought about by changes in the physical features of the earth's surface. It is inconceivable that the pole could have wandered away and returned during the relatively short interval of an interglacial period, and there is no evidence of rapid changes in the distribution of land and sea during the interglacial periods. Hence we are thrown back on to changes of solar radiation as the only possible cause. We are therefore led to examine what would be the effect on a polar climate of changes in solar radiation.

To fix our attention, we will consider what would be the effect of a change in solar radiation on a region which at present is glaciated because the summer temperature is below the freezing-point.

We will first examine the consequence of a reduction in the solar radiation. We have already seen that the temperature in all latitudes falls when the solar radiation decreases; therefore the mean temperature at our station will also fall. We also saw that a decrease in solar radiation results in less cloud and precipitation. In our case the precipitation decreases for two reasons: first, the air carries less moisture because the temperature is low; and secondly, less moisture is carried to the station because the general circulation of the atmosphere has decreased. Thus the net result of the decrease in the solar radiation is a lower mean temperature and less snowfall. In consequence, the thickness of the ice covering would decrease, and if the reduction proceeded far enough, large areas might even become free from snow.

If the solar radiation increased, we should have a reverse effect. The mean temperature would rise and the precipitation increase, and the result would be an increase in the thickness of the snow covering and all glaciers would increase in thickness and length.

In a recent paper, Meinardus has discussed a similar problem from an entirely different point of view. Starting from the observed fact that the ice covering in the antarctic was once much thicker than at present, probably two or three times as thick, Meinardus discusses all the factors which could have affected the snow covering, and reaches the conclusion that the former thickness of the ice can only be explained by a higher temperature accompanied by an increase in the general circulation of the atmosphere. He calculates that for the outflow of the ice from the present antarctic continent to have been three times as great as at present, the mean temperature must have been 4° C. higher and the circulation doubled.

This is strong independent support of the conclusion that an increase of solar radiation would increase the glaciation of the region we are considering. This, however, would only be the initial effect of increasing the radiation; if the increase progresses, there will come a time when the increased temperature produces melting in the summer. From this point on, melting becomes more and more important, until finally the annual

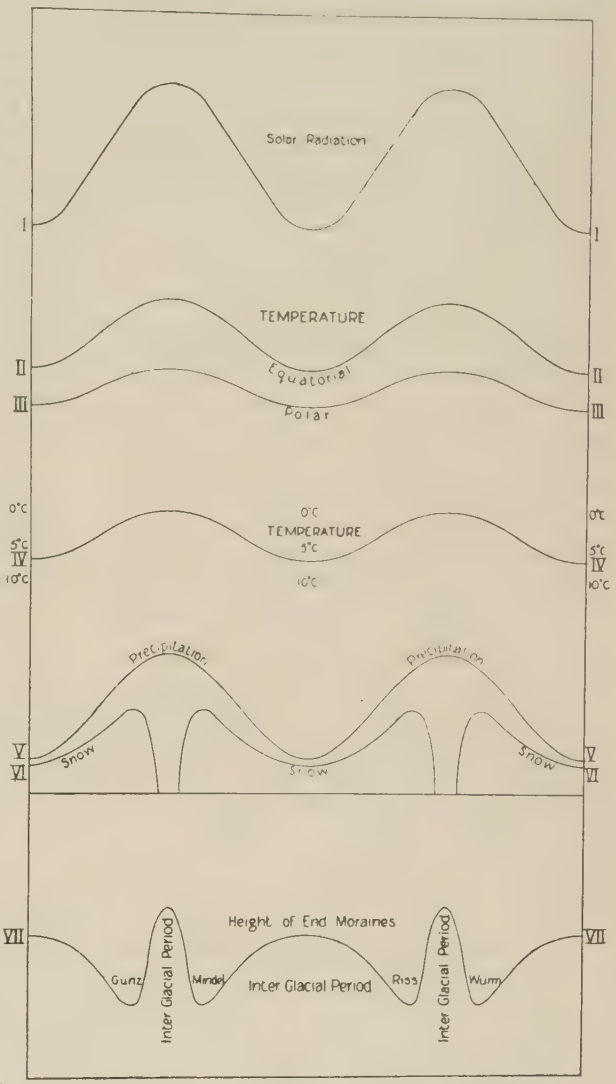

FIG. 1.—Effect of two cycles of solar radiation on glaciation.

melting might be as great as the annual snowfall, when the ice covering would disappear. This comes about in two ways: (1) the period of snowfall would be reduced owing to the raising of the mean annual temperature, and (2) the summer melting would be increased in intensity and continue for a longer period.

It appears to me that these considerations give us a possible clue to the meteorological conditions during the great ice ages in the Pleistocene Period.

We have already seen that changes in solar radiation can produce changes which materially

alter the amount of glaciation, and obviously the next step is to follow through the whole sequence of changes which would result from one or more complete cycles of change in solar radiation. To do this I have prepared a diagram based on two cycles of solar change. In Fig. 1 the abscissæ represent time, but no scale of years is attached as we have at present no clue to the absolute time involved : it is sufficient to say that we are dealing with a unit of a thousand years rather than with a unit of years. Curve I represents two complete cycles of solar radiation. The variation of radiation only is represented, but what proportion this variation has to the total radiation it is impossible to say, nor is it necessary to inquire at this stage. The variation in solar radiation produces a change in temperature, the change being larger at the equator than at the pole : this is represented by Curves II and III, which show the relative changes in temperature in equatorial and polar regions respectively.

In order to follow the effect of these changes, it is necessary to fix our attention on some definite

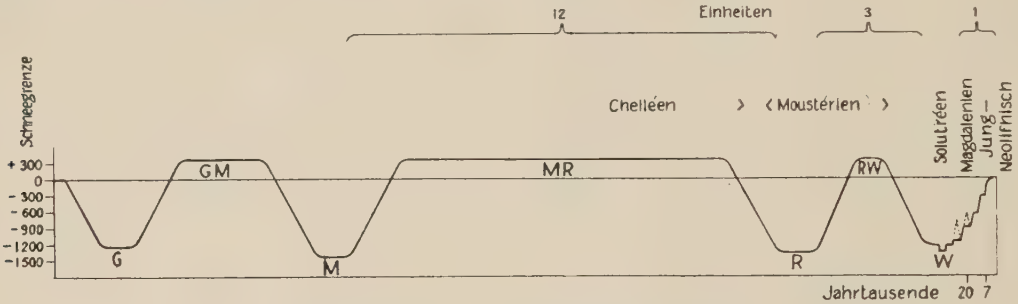

FIG. 2.—Penck and Brückner's diagram of the succession of ice ages in the Alps. The abscissæ are time and the ordinates the height of the snowline.

regions, for it is clear that the effect will vary greatly from latitude to latitude. Let us choose a place which has a mean annual temperature of 0° C. during the warmest epoch. We have no idea of the magnitude of the temperature oscillation at such a place, but we will assume that it is about 7° C. Curve IV has been drawn to represent a temperature oscillation of this amount, as shown on the scale of degrees attached. It is clear from what has already been said, and also from Curves II and III, that periods of maximum radiation are accompanied by increased difference of temperature between equatorial and polar regions, the consequence being greater general circulation of the atmosphere, more cloud and more precipitation, if not in all latitudes at least in equatorial and polar regions. Thus there would be variations in precipitation in our region in step with the changes of solar radiation and temperature. This is shown diagrammatically in Curve V, which, however, is not drawn to any scale, so that the absolute value of the oscillations is not indicated on the diagram.

At the epoch of minimum temperature—the extreme left of the diagram—the mean annual temperature is −7° C.; by hypothesis, therefore, the summer temperature will probably rise to the freezing-point and there will be a certain amount of melting. Curve VI, which represents the annual accumulation of snow, therefore starts somewhat below the curve of precipitation. With the increase of temperature the proportion of the total precipitation which remains as snow decreases, and when the mean annual temperature, as shown on Curve IV, approaches the freezing-point, the melting exceeds the snowfall and there is no residual snow to accumulate. Thus the accumulation of snow increases from the epoch of minimum radiation, until a point is reached beyond which the continued rise in the radiation produces a rapid diminution in the snow accumulation, which in the particular conditions we are discussing entirely disappears at the epoch of maximum radiation. As the radiation decreases from its maximum, the same changes take place in the reverse order.

The significance of these changes is best realised by considering that the locality we are investigating is a mountainous region. In this case the snow which accumulates year by year flows off the mountains through glaciers. The thickness and length of a glacier depend much more on the amount of snow which accumulates than on the temperature of the region into which it flows. Thus each glacier will descend far down the mountain-side during each period of accumulation, and this is shown by Curve VIII, which represents the height on the mountain slopes where the end moraines of the glaciers would be met with at each period. This diagram shows us that with the two periods of solar radiation we should have had four distinct advances and retreats of the glaciers and that the advances occur in pairs, the interval between two pairs being considerably greater than the interval between the members of each pair.

Now there can be no doubt that during the great Ice Age the glaciers of the Alps did advance and retreat just in the manner here described. This is best shown by reproducing a diagram prepared by A. Penck and E. Brückner to illustrate the conclusions of their great investigation of the glaciers of the Alps during the Ice Age (Fig. 2). The similarity between this diagram and my Curve VIII is unmistakable, and I feel justified in adding to my diagram the names Gunz, Mindel, Riss, and Würm to the four maxima of glaciation and to describe the intervals between them as interglacial periods.

So far, we have considered only the conditions

in or near the polar regions where glaciation is the predominating evidence of change of climate. What changes should we expect to see in other regions of the world? Changes of temperature are difficult to recognise geologically, except in polar or desert regions, but changing precipitation leaves a very clear record in the strand lines of lakes and inland seas. Now it is generally recognised that during the ice age there were great variations in the levels of lakes, so much so that the term pluvial periods has been introduced to specify these periods. Is there any relationship between these pluvial periods and the ice ages? In the 'Great Basin' in North America there is clear evidence of the pluvial periods. According to Gilbert and Russell, both Lake Bonneville and Lake Lahontan show two periods of high level between which both lakes were completely dried out and desiccated. They also found clear evidence of glaciers entering the enlarged lakes, showing that one at least of the maximum epochs of the lakes coincided with one of the North American ice ages. The pluvial periods have also left clear traces in equatorial Africa, and here again the evidence points to two main pluvial periods, the first of which, according to Wayland (see NATURE, Aug. 17, 1929, p. 279), corresponds to the Günz-Mindel Ice Age and the second to the Riss-Würm Ice Age. Thus in both North America and in Africa there have been during the Pleistocene Period two main pluvial periods, while in polar regions there have been four ice ages.

Whether the theory of the cause of the interglacial periods which I have sketched here will prove to be correct or not can only be determined after years of research, and, in discussing it, account must be taken of possible movements of land masses and possible shifts of the poles. I do not propose to go into any further details here, but will simply direct attention to several consequences of the theory which should be touchstones for testing it:

(*a*) The four glacial ages occurred during periods of relatively high temperature in all parts of the world.

(*b*) There are two kinds of interglacial periods: (1) warm interglacial periods which occur between the two members of each pair of glacial periods; (2) cold interglacial periods corresponding to the interval between the occurrence of the pairs of glacial periods.

(*c*) Each pair of glacial periods, with the intervening warm interglacial period, coincides with a pluvial period in unglaciated regions.

RECENT CHANGES IN CLIMATE.

There has been much controversy regarding climatic changes in historical times. It is impossible for me to go into the details of this controversy, but I think I may fairly sum up the discussion by saying that there is little evidence for any appreciable change in temperature, but that there is quite a mass of evidence for moderate changes in the amount of rainfall. It is clear that the historical period is much too short to show any appreciable part of the large but slow changes which give rise to the main changes of climate shown in the geological record and of which the ice age is the last example. These changes probably required 20 or 30 per cent in the change of solar radiation. Any change in the historical period must have been of the order of only a few per cent, and probably took the form of minor fluctuations on a more general change.

Now I have tried to show that the effect of changes in solar radiation are chiefly counterbalanced by a change in the general circulation of the atmosphere and increased cloud and precipitation rather than by large changes in the temperature. It is not surprising, therefore, that what fluctuations there have been are shown chiefly by fluctuations in rainfall; the best evidence of which is seen in the changed level of lakes without efflux, the changed boundaries of deserts, and the relics of old cultivation in places where now cultivation is impossible.

Dog Distemper and Immunisation.

By P. P. LAIDLAW, F.R.S.

SOME seven years ago the *Field* Distemper Fund was inaugurated with the object of encouraging the study of dog distemper, in the hope that the ravages of this disorder might be mitigated through the discovery of some preventive measure or some satisfactory method of treatment. The *Field* Distemper Council, which body administers the *Field* Distemper Fund, joined forces with the Medical Research Council for the purpose of this study, and a scientific committee, composed of veterinary and medical men, was formed to supervise the research work. The Medical Research Council is interested in dog distemper as it is an example of an acute infectious fever, comparable in many respects to such diseases as influenza or measles in man, and it was hoped that the study of the canine fever would ultimately lead to a better understanding of such infectious fevers in man.

The highly infectious nature of distemper rendered the study somewhat difficult, for it was necessary to take elaborate precautions throughout the investigation in order to guard against accidental spread of the disease. New buildings were constructed for the work and dogs were bred, in the strictest possible isolation, for the purposes of experiment. Progress was thus inevitably slow, but it is now clear that without the special equipment and in the absence of the rigid precautions against accidental infection, it is highly probable that little progress would have been made.

The demonstration of the fact that ferrets were very susceptible to dog distemper was of great assistance to the work, for it was found to be possible to experiment in the first instance with this species, which is relatively easy to maintain in close confinement and strict isolation, and reserve the specially

bred dogs for crucial experiments. The facts disclosed in the study of the disease in ferrets have been shown to be applicable to the disease in dogs with only minor modifications.

At the time the work for the *Field* Fund was commenced, the nature of the infectious agent in dog distemper was not firmly established. Carré, in 1905, came to the conclusion that the disease was caused by a filterable virus. He quoted experiments to show that the contagium would pass through the pores of filters specially designed to hold back all ordinary bacteria, and he found that the disease could be transmitted with material in which no structures resembling bacteria could be detected under the microscope and from which no bacterial cultures could be secured. Carré's view did not meet with general acceptance, and from time to time various visible bacteria, which were regarded as causal organisms, were secured from distemper cases. That infection with ordinary bacteria did occur very frequently in distemper cases was undoubted, but it was by no means clear which of the several bacteria recovered from diseased animals should be regarded as the primary cause of the disorder and which the secondary, or if, under the view put forward by Carré, all the visible bacteria were really secondary infective agents and the true contagium was an ultramicroscopic virus.

The workers for the *Field* Fund confirmed Carré's findings in all essential particulars and showed that the disease could be transmitted, at will, by the blood and tissues of distemper cases through an indefinite series of animals. The infective material appeared to be sterile in all the usual laboratory culture media and no bacteria could be demonstrated by microscopic examination. Further, the infective principle was shown to pass through bacterial filters of standard type and proven quality. It thus seems established that dog distemper is primarily a virus disease and that all the bacteria which can be recovered from distemper cases are really secondary invaders of damaged tissue. It was further obvious that preventive measures should be directed against the virus infection in the hope that, if this could be eliminated, the secondary invading organisms would be deprived of their aggressive ally and rendered almost, if not quite, impotent.

It was found that distemper virus could be inactivated or killed in a number of different ways and that, provided the treatment to which the virus was submitted was not too drastic, the inactivated virus formed an efficient vaccine. That is to say, a large dose of inactivated virus could be injected into an animal with complete impunity and, after the lapse of some days, the recipient of the vaccine developed a resistance to injections of fresh living virus. Supplies of virus cannot be secured by artificial culture methods, as is the case with ordinary bacteria, and recourse was therefore made to the tissues of distemper animals as a source of crude virus. The lymph glands, spleen, and liver of distemper animals nearly always have a high virus content and they can be converted into an efficient vaccine, without much difficulty, by means of small doses of formaldehyde. It was found to be possible to immunise more than 90 per cent of ferrets by giving them a single injection of vaccine made from distemper ferret tissue. Similarly, it was found to be possible to render dogs resistant by means of a single dose of vaccine made from tissues of a distemper dog. The resistant state which develops in a dog or ferret after the injection of vaccine is converted into a solid and durable immunity by the injection of living virus. Animals so treated have been given massive doses of distemper virus and they remained unaffected; they have been deliberately placed in contact with severe cases of natural distemper, complicated by secondary infections and without complications, and they have not developed the disease.

After the method had been shown to be almost uniformly successful under experimental conditions, the method was extended to the field and several hundreds of foxhounds and other breeds of dogs were first vaccinated and then given a small dose of living virus. It was hoped that this procedure would give as solid and as durable an immunity as that which follows a recovery from the natural disorder and yet be comparatively free from risks. It was realised that the injection of living virus could never be made absolutely safe, but the immunity which follows recovery from the natural infection, however mild, is so firm and so durable that a final dose of living virus should guarantee real immunity in the vast majority of instances. The resistance set up by vaccine alone, though very definite and significant, was scarcely great enough to be called immunity, and it was doubtful if it would, by itself, render a dog immune for life. The results of this extended field trial were satisfactory in that the great majority of the hounds and dogs came through the immunisation process with no trouble and afterwards proved to be immune to epizootic distemper, which caused severe illness and even death in their unvaccinated companions. In a small percentage of cases the living virus caused a severe reaction in the vaccinated dog, but this was usually of short duration and was followed by complete recovery. In less than one per cent of cases death followed the administration of the virus. The production of the prophylactic has now been undertaken by a commercial firm in Great Britain and by another in the United States of America, and several thousand doses have been issued.

It is not possible to pass any final judgment on the method at the present time. It is clear that the use of living virus carries with it some risk, for its inoculation causes, even in the vaccinated dog, a considerable strain on bodily health, and unless the recipient is free from all forms of infection grave harm may ensue. It is also necessary to remember that the immunisation against the virus disease is no guarantee against infection by bacteria, which may cause bronchitis, pneumonia, gastro-enteritis, and so on, but on the other hand, immunisation should diminish the incidence of these diseases, for it seems clear that the virus frequently weakens the dog's resistance and thus assists bacterial invasion.

Immunisation should prevent, in large measure, the epizootic disease which causes such heavy losses year by year in the canine population.

It may be noted here that this vaccination against distemper is merely a special case of protection against a virus disease by means of inactivated or dead virus. Very similar results have been recorded recently in other diseases such as rabies, rinderpest, fowl plague, and foot-and-mouth disease. In the case of foot-and-mouth disease the matter is complex, for it is now clear that there are at least three strains of virus causing this disorder, and immunity to one strain does not carry with it immunity to either of the others. So far as information goes, there appears to be only one strain of distemper virus, and a dog or ferret which is solidly immune to a virus from one source is immune to strains from other sources.

The study of distemper has not so far proved illuminating as regards the infectious fevers of man. Vaccines made from homologous tissues are clearly not available in the case of man, and yet the hope is raised that if only artificial cultures could be secured, we might make from them vaccines which would do much to minimise the disharmonies produced by the infectious fevers.

Obituary.

PROF. CHARLES CHILTON.

DR. CHARLES CHILTON, whose death on Oct. 25 is reported from Christchurch, New Zealand, had a career which was in several respects noteworthy. He overcame a physical handicap that might have excused a somewhat passive attitude to life, and he practised in turn three different professions without failing of success in any of them.

Chilton was born at Leominster, Herefordshire, in 1860 and was taken to New Zealand as a child. In his boyhood an accident led to the loss of a leg and incapacitated him from following his father's occupation of farming. It was on this account that he became a student at Canterbury College, where he studied natural science and came under the influence of Capt. Hutton and Sir Julius von Haast, afterwards graduating with honours in zoology. He was a schoolmaster for some fifteen years, first at Christchurch and later at Port Chalmers, where he became headmaster of the High School. He found, however, that the demands of the teaching profession left little opportunity for the pursuit of his favourite studies in zoology, and in 1895, when already approaching middle age, he did what few men would have ventured to do; he resigned his position and came back to Great Britain to enter as a medical student at Edinburgh. His stay in Edinburgh was punctuated with medals and scholarships, and in 1898, after a period as house surgeon in the ophthalmic ward of the Royal Infirmary of that city, he travelled on the Continent, studying diseases of the eye at Heidelberg and Vienna, and returned to Christchurch, where he set up as an ophthalmic surgeon.

All this time Chilton had been giving his spare hours to zoology and had published a series of important papers on the Crustacea. When the late Prof. Dendy received a year's leave of absence from his chair at Christchurch, it was natural that Chilton should be appointed to take his place. Dendy, however, did not return, for during his absence he received a call to King's College, London, and Chilton became professor of biology in Canterbury College. He at once made his mark as a teacher and also as an investigator, although the administrative side of academic life absorbed, as it always does, more and more of the time that should have been given to research. In 1921 he was appointed rector of his college, a position which he held until the end of 1927, when he had to resign following a breakdown of health due to overwork. Recent letters spoke of his health as completely restored, and his death after a few days' illness of pneumonia was unexpected.

Chilton had a high sense of the scientific man's duty to the community in which he lived, and although he never sought municipal honours, he was prominent in the affairs of his city and province, taking the lead in many movements relating especially to education and the public health. He revisited Great Britain in 1912 as one of the representatives of New Zealand at the Congress of Universities of the Empire, renewing old friendships in scientific and medical circles and receiving the honorary degree of LL.D. from the University of Aberdeen. A heavy blow fell on him when his only son was killed at Gallipoli.

Living in a country of which the invertebrate fauna is still very imperfectly explored, Chilton took the view that the most immediate need of biological research was the thorough exploration of this fauna and the study of its ecological and geographical relations. He early specialised on the Crustacea, and most of his published work refers to this group. In 1891 he published, in the *Records of the Australian Museum*, a paper on "A New and Peculiar Freshwater Isopod from Mount Kosciusko" in New South Wales. This was *Phreatoicus australis*, the first fully described member of a new sub-order now known to contain a considerable number of species in the freshwaters of Australia, Tasmania, and New Zealand. The more recent discovery of a species at the Cape has afforded striking additional evidence of faunal affinity between the South African and Australasian regions. Chilton, as a result of his detailed study of the structure of *Phreatoicus*, pointed out "that the group must be of very considerable antiquity", and thirty-five years later he had the good fortune to confirm his own prediction by describing a fossil *Phreatoicus* from the Triassic rocks of New South Wales.

Another subject to which Chilton gave much attention was the fauna, and especially the Crustacea, of subterranean waters. His memoir on the

subterranean Crustacea of New Zealand, published in the *Transactions of the Linnean Society of London* in 1894, revealed the existence of a very peculiar fauna, including a blind species of *Phreatoicus*—which had been briefly described some ten years before—and other forms the affinities and probable origin of which were discussed in detail.

In 1907, Chilton took part in an expedition to the sub-antarctic islands of New Zealand, organised by the Philosophical Institute of Canterbury, and he edited the volumes in which the results of the expedition were recorded, as well as contributing the section on Crustacea. One of the many enterprises in his later life was the establishment of the mountain biological station of Canterbury College at Cass, originally suggested by Dr. L. Cockayne, for the investigation of the ecology of the New Zealand Alpine flora and fauna. W. T. C.

By the death of Prof. Naomasa Yamasaki, geographers and seismologists are deprived of an active and very able colleague. A notice of his life and work appears in *Proc. Tokyo Imp. Acad.*, vol. 5, pp. xviii-xx, 1929. Born on Mar. 10, 1870, he was educated in the College of Science in the Imperial University of Tokyo, and in 1899 he was sent by the government to Europe for three years to study geography. In 1902, on his return, he was appointed lecturer, and in 1911 the first professor, in geography in the College of Science. As a young geologist, he was keenly interested in the eruption of Bandai-san in 1888 and the Mino-Owari earthquake of 1891. Later, he published reports on Yakedate, Miharayama, and other Japanese volcanoes, in which their structures and morphological developments were explained in detail. His last work was one, in collaboration with Prof. Imamura, on the tilting movement in the blocks of the Fuji volcanic zone bordering the Japan Sea. To seismologists, Prof. Yamasaki is best known by his valuable memoirs on the physiographical relations of the recent Kwanto, Tajima, and Tango earthquakes. During the last year of his life, Yamasaki suffered from heart disease, from which he died on July 26.

We regret to announce the following deaths :

Dr. E. W. Allen, chief of the office of experimental stations of the U.S. Department of Agriculture and vice-president in 1920 of Section M of the American Association for the Advancement of Science, on Nov. 11, aged sixty-five years.

Prof. Leonard S. Austin, metallurgical engineer and chemist, at one time professor in the Michigan College of Mines, on Oct. 29, aged eighty-three years.

Mr. William Hewitt, formerly director of technical education in Liverpool, who was keenly interested in the regional survey work of the University and in 1922 published a book on the Wirral peninsula, on Nov. 27, aged seventy-eight years.

Dr. Frederick Montizambert, C.M.G., I.S.O., formerly Director-General of Public Health and Sanitary Adviser to the Canadian Government, the doyen of the public health service in Canada, on Nov. 3, aged eighty-six years.

The Hon. Athelstan John Henton Saw, Chancellor of the University of Western Australia, on Nov. 28, aged sixty-one years.

News and Views.

Prof. Robert Robinson, the new Waynflete professor of chemistry in the University of Oxford, may be aptly described as the most brilliant pupil of his illustrious predecessor, the late Prof. W. H. Perkin. His association with Prof. Perkin began in Manchester, and he remained in communion with his former teacher throughout an academic Odyssey which led him in turn to chairs in the University of Sydney (1912), Liverpool (1915), St. Andrews (1921), Manchester (1922), and London (1928). A long-continued collaboration with Prof. Perkin was directed mainly towards the solution of outstanding problems in the chemistry of alkaloids ; and the researches of Perkin and Robinson on narcotine, harmine, harmaline, etc., have become classical. Prominent among Prof. Robinson's independent work in this group is a masterly paper, published in 1917, detailing possible ways in which many of the familiar alkaloidal skeletons may be conceived to originate in the plant by means of comparatively simple reactions. The elegant simplicity which is a characteristic feature of Prof. Robinson's synthetic work is illustrated by his production of tropinone through the direct interaction of succindialdehyde, methylamine, and acetone—a veritable ' test-tube reaction ' which supplanted a laborious synthesis of some twenty steps.

In a series of later studies, dealing largely with the structure and synthesis of other plant products, Prof. Robinson has made notable advances in the chemistry of the anthocyanins and related substances ; in general, also, his work has thrown much new light on the possible mechanisms of plant metabolism. In another direction he has exercised his influence upon the development of industrial organic chemistry in Great Britain ; while, among his numerous contributions to pure theory, specific mention may be made of his application of the electronic theory of valency to organic chemistry. His highly original and distinctive work was recognised by the Chemical Society in the award to him of the Longstaff Medal in 1927. It is fortunate that British organic chemistry, at a critical juncture in its development, should be able to provide a master of synthesis, endowed with a profound knowledge and command of natural organic products, to succeed to this important ' key ' chair at Oxford.

Very hearty congratulations will be extended to Prof. Sydney Howard Vines, eminently distinguished in botanical science, who celebrates, on Tuesday next—the last day of the year—his eightieth anniversary of birth. A Londoner, he was educated at private schools, graduating in due course at Christ's College, Cambridge. Vines enjoyed the privilege of personal association with Huxley through the courses of instruction in general biology devised by the latter and conducted in the early 'seventies at South Kensington. When an undergraduate of Christ's College, he was

offered an appointment there as demonstrator in the teaching of botany, and fulfilled duty jointly with Thiselton-Dyer and others. Of those early experiences Prof. Vines has recorded that "it was a great, almost oppressive, honour to be introduced to Huxley as one of his junior assistants". Fellow of Christ's College, 1876–88, Vines was University reader in botany, 1883–88, following which he was appointed Sherardian professor of botany in the University of Oxford, retiring in 1919, after thirty-one years' service. He was president of Section K (Botany) at the Bradford meeting of the British Association in 1900, when he gave, in his address, a summary of the position and progress of botany in the nineteenth century. Prof. Vines was president of the Linnean Society, 1900–4, a term of office memorable for the sanction of a supplemental charter enabling the election of women to the fellowship. In 1906 a body of subscribers presented his portrait to the Society, painted by the Hon. John Collier; it hangs in the Society's meeting room at Burlington House.

AN announcement of very great importance to students of ancient man has been made by Prof. Sergio Sergi, of the Anthropological Institute of the University of Rome. He has just published in the *Revista di Antropologia*, vol. 28, p. 3, a preliminary note on the skull of a Neanderthal woman discovered in a pit or quarry situated in the north-eastern outskirts of Rome. The pit lies in the valley of the Aniene, a tributary of the Tiber, and exposes deposits of the Quaternary period. Although the culture of Neanderthal man—the Mousterian culture—has been found in many parts of Italy—particularly in the lower valley of the Aniene—hitherto no trace of the fossil remains of Neanderthal man has been discovered. The skull was found embedded in a stratum of gravel which is rich in the remains of pleistocene mammals, including *Elephas antiquus*, *Hippopotamus major*, and *Rhinoceros Mercki*, a fauna indicating a mid-pleistocene date. The geological evidence points definitely to the stratum wherein the skull was found, which at other places has yielded Mousterian implements, as having been laid down in the interglacial period which preceded the last great glaciation—the Riss-Würm interglacial. From the photographs published in Prof. Sergio Sergi's preliminary note, it can be inferred that the Aniene skull is almost a duplicate of the original Gibraltar skull, with the same cranial capacity of about 1200 c.c. Anthropologists will look forward to the publication of the full account of this skull—one of the most complete specimens ever found. Prof. Sergio Sergi is the son of the distinguished Nestor of anthropologists, Prof. Giuseppe Sergi of Rome.

THE National Institute of Industrial Psychology is making a public appeal for £100,000 to assist in its research and educational work. The Institute was founded in 1921 as a scientific association, and therefore can make no profits. Much of its work is concerned with the carrying out of special investigations in factories on the many problems that arise in connexion with the human side of industry. These investigations are paid for by the firms concerned, but if the Institute's services are to be of the greatest value the scientific basis of its work must be maintained by fundamental research. Moreover, there is an ever-increasing demand for the dissemination of the specialised knowledge the Institute's investigators have acquired by their research and experience. Such educational work cannot be made self-supporting, but unless it is systematically undertaken, much of the knowledge gained by the Institute will fail to be of practical value. The Institute has already received very generous support for its research work from the Carnegie Trustees and the Laura Spelman Rockefeller Memorial, but the time has now come when it must make a wider appeal if its efforts are to be fruitful of the best results. The Institute has made such rapid progress since its inception that there can be little doubt that it fulfils a very real need in national industrial life, but it is clear that its future progress can only be assured if it has adequate funds for research and education.

AN appeal for funds is being made on behalf of the excavations which are now being carried out by Mr. and Mrs. Guy Brunton at Badari in Middle Egypt. The excavations in this area were initiated by the British School of Archæology in Egypt at Qau in 1922, when Mr. Brunton was in charge of the expedition. During the last two seasons the expedition, which since the operations of the School have been withdrawn from Egypt has been working independently, has brought to light remains of the various predynastic cultures, and has discovered the first evidences of the Tasian civilisation, a culture which apparently is the oldest known in the Nile Valley. The Badarian and Tasian cultures have provided us with evidence of agriculture, weaving, and metal working at a date long before these could have been expected. Unfortunately, tomb robbing is particularly prevalent in the area, and unless immediate advantage is taken of the opportunity, scientific investigation will before long be impossible. Up to the present, the expedition has had little support and the expenses have been met privately. As it is not possible to carry on the work indefinitely without assistance, an appeal is now made for subscriptions. The expedition works under the auspices of the British Museum, which receives the greater part of the objects found in so far as these are not retained for the Cairo Museum by the Egyptian authorities. Subscriptions should be sent to the Director of the British Museum.

THE more detailed reports of Col. and Mrs. Lindbergh's archæological survey by air in the south-west United States and Maya area of Central America, which have now been issued by the Carnegie Institution of Washington, suggest that this instrument of research, which has proved its value in the archæology of Britain and the Old World generally, is likely to be of even greater assistance to American archæologists. Two reconnaissances were made by the Lindberghs with the co-operation of the Pan-American Airways and the Carnegie Institution. In the first, several days were spent in flights from the well-known archæological site of Pecos, New Mexico, as base. More than a hundred photographs were taken,

and while flying over the Cañon de Chelly, several hundred miles from Pecos, a number of small ruins were discovered which, though not far distant from one of the archæologists' camps, had not previously been found, or apparently ever visited by a white man. On the second expedition, Belize was made the base, and in flights extending over four days the principal Maya sites were visited, some hundreds of miles of impenetrable forest were traversed, and at least four entirely new and unvisited Maya cities were discovered.

FROM these two reconnaissances by air it is evident that the employment of the aeroplane holds out advantages of the greatest moment to American archæologists. It affords a means of rapid transport—transport being one of the greatest difficulties of the archæological explorer, especially in the tropical forest of Mexico. The journey from Tikal to Uaxactun, usually a long day's journey by mule train, was accomplished in six minutes. Further, it can pass over forests practically impenetrable on foot, thus leading to new discoveries and transporting workers to those sites which cannot or at any rate have not yet been reached. Lastly, it will make possible a survey and accurate map, not only of the ruins themselves, but also of the surrounding geographical features which cannot now be observed from the ground. These latter, it need scarcely be pointed out, are of vital import in the attempt which American archæologists are now making to reconstruct the social and economic life of the earlier cultures of the region.

THE most remarkable rains in the British Isles during the past forty years were dealt with by Dr. J. Glasspoole in a paper entitled "The Areas Covered by Intense and Widespread Falls of Rain", read at the Institution of Civil Engineers on Dec. 17. The engineer dealing with town drainage is concerned mainly with intense rains of at most a few hours' duration, while in the case of large catchment-areas prolonged rains lasting, with breaks, as long as a week are likely to be more disastrous. Three variables, therefore, have to be dealt with, namely, rainfall-quantities, the duration of rainfall, and the areas covered by these rains. The heaviest orographical rains spend their force on the mountains, giving little rain in the adjacent low-lying regions. Cyclonic rains are not so restricted, and the whole of a catchment-area may be equally affected. Both types are generally sustained rather than intense. Intense rains in the British Isles are confined especially to England, more particularly central, southern, and eastern districts. Further, more intense rains have occurred in London than in any other region of similar size. They are typically thunderstorm rains of five hours' duration or less, long sustained falls being relatively rare there. Little information is available concerning the areas covered by intense falls of one hour or less. In such cases it seems more likely that determinations could be obtained from the measurements of the discharge from small areas than from the records of rain-gauges.

THE attention of all systematists is invited to an appeal by Dr. Handlirsch (*Zool. Anz.*, **84**, p. 85; 1929) against the excessive splitting of systematic groups. As he rightly says, *Systematik* is and must remain the backbone of zoology, but it is an exacting study which is apt to absorb the whole energy of the systematist and to leave him little time, or perhaps inclination, to look around him at his fellow-workers in zoology. It is often not realised that the excessive splitting of genera and species leads, as Handlirsch points out, to the obliteration of clues to phylogeny, and makes systematics more and more a study of its own, confined to a narrow professional class. He gives examples among insects of the splitting of genera, and others could be found in every group. One might say that one ceases to be able to see the wood for the trees. As a matter of practical convenience, there is much to be said for the reduction of large genera to more manageable dimensions, but phylogeny is best expressed by retaining the original name and separating subgenera within it. The indefinite multiplication of names has introduced immense difficulties, not least of which is the application to them of nomenclatural rules. Handlirsch gives the example of the gorilla, orang, and chimpanzee. If these are separated as genera, there arises dispute as to which should retain the name *Simia*. Would it not be better if all were included in the old genus and distinguished when necessary as subgenera?

THE Report of the Industrial Fellowships of the Mellon Institute at Pittsburg University for 1928–29 relates to the eighteenth year of the working of the late Prof. Kennedy Duncan's foundation. On Feb. 28, 1929, there were 62 Industrial Fellowships in operation, employing 145 research specialists and assistants, and about £160,000 was paid during 1928–29 by the fellowship donors in support of researches in the Institute. These statistics furnish eloquent evidence of the permanent success of the scheme. A recent development has been the establishment of a pure research department, but judging from the investigations in progress in this department, many of which are medical and pharmacological, its name does not appear to be specially appropriate. The Report gives a schedule of the researches in operation during the year, with names of the fellows and their assistants. In addition to the Report, we acknowledge with thanks receipt of the pamphlet containing the list of books and bulletins, journal contributions, and patents by members of the Institute during the year 1928, copies of which are available for chemists, librarians, and teachers.

THE speed of transport by road has enormously increased during the last few years. A similar speeding up of electric express trains is now noticeable abroad. In the *Bulletin Oerlikon* for November, there is a description of four locomotives for the Paris-Lyons-Mediterranean Railway (P.L.M.) which have just been completed. The most noticeable characteristic is that the maximum speed has now been increased to 80·7 miles per hour. The first of these locomotives was put into service at the end of June on the Mont Cenis line. These locomotives have the highest output of any yet built, being rated at 5400 horse power. The locomotives are no less than 78 feet long, have 18 wheels, and weigh 156 tons. They are capable of giving a

total tractive effort at the wheel rims of 40,000 pounds weight. The body of the locomotive is mounted on two bogies, each having three driving axles with corresponding twin motors. There are thus twelve motors on a locomotive, and they can be grouped together in various ways so that a large number of economical running speeds can be obtained. The closed-off driver's cabs at each end are connected together by two lateral gangways. The sides and roof of the central compartment which contains the electrical apparatus can be detached for inspection when necessary. All the parts of the equipment which are not dangerous to handle are arranged along one of the gangways. All the high-tension switch gear is mounted along the other gangway and is unprotected as the entrance doors to it can only be opened when the current collectors are lowered and the main switch is open. The current is collected from the overhead line by two pantograph collectors and is returned to the third rail by means of four contact shoes on each side of the locomotive.

WITH the issue of the December number *Antiquity* completes its third year of publication. This is an achievement upon which we offer the editor our hearty congratulations. Those who have any conception of the difficulties which beset the production and publication of a periodical which, while being popular in the best sense of the term, maintains a high scientific standard as well as a topical interest in its articles, will appreciate the courage which was required to start it and the indefatigable energy which has been necessary, not merely to maintain the initial aim, but even to go beyond it. In his introductory remarks to the December number, the editor points out that the very success of his publication constitutes its danger, as it has now come to be looked upon as established, though this is far from being the case. The contents for December strongly reinforce the editor's plea for further support from the public. They all deal in an authoritative, but not too technical, manner with matters which are more or less to the fore in archæology at the moment, and, above all, they are fully illustrated. The editor himself, in an article entitled "Woodbury", describes two photographs which "represent the culminating point of archæological air-photography"; Miss Caton-Thompson gives the first illustrated account of her excavations at Zimbabwe to be published in England; Dr. Oscar Reuther here makes the first report on the German excavations at Ctesiphon, which are opening up a new world; and Mr. G. Brunton describes the Badarian and Tasian civilisations—the most ancient civilisations of Egypt. These are some only of the contents of an excellent number, in which the news items are not the least entertaining and informative feature.

THE second meeting of Australian physicists, organised by members of the Institute of Physics, was held in Melbourne on Aug. 20–23; fifty delegates from all parts of the Commonwealth attended. The meeting was clouded by the sudden death, just before, of two of the most prominent personalities at the previous Conference at Canberra—Dr. Bieler, of the Imperial Geophysical Experimental Survey, and Dr. Duffield, Director of the Commonwealth Solar Observatory. There was a liberal and varied programme of papers. A discussion on seismic prospecting was opened by Prof. A. O. Rankine, whose short stay in Australia happily included the time arranged for the meeting. A preliminary account was given by Major Booth and Mr. R. L. Aston of the progress of experiments in New South Wales on the possibilities of the seismic method, which had been included in the scope of the geophysical survey at the suggestion of the Canberra meeting. Dr. N. B. Lewis spoke on work with the gravity balance, and a preliminary description of a gravity balance of new design was given by Prof. T. H. Laby. Prof. Kerr Grant, of Adelaide, described an improved type of Kater pendulum, in which the planes on which the pendulum swings are spaced by an end rod of Johannsen type. Astronomical contributions were made by the Melbourne and Mt. Stromlo Observatories, and meteorological papers from the Carnegie Institution Magnetic Observatory at Watheroo (W.A.) were read. Papers on X-rays, ionic mobility, heat, were given by the University of Melbourne, Natural Philosophy Department, and some papers on various phases of wave mechanics by Mr. H. S. W. Massey. Mr. A. H. Turner, recently appointed physicist in charge of the Commonwealth Radium Laboratory, described arrangements made for the safe housing of ten grams of radium, and gave an account of accurate methods of measuring quantity. Mr. Z. A. Merfield described some modifications carried out, with Sir Thomas Lyle, of the Grayson ruling machine.

AN article on electrification in Russia, by Dr. Segal, which appears in the *Electrical Review* for Dec. 13, illustrates the ambitious programme of construction and extension which has been undertaken by the U.S.S.R. It is a continuation of the original programme initiated in 1920, which provided that by the year 1933 there would be 39 regional power stations working. This has now been increased to 48, having a total capacity of about three million kilowatts. It is contemplated that by 1934 the total capacity will exceed four and a half million kilowatts. The government considers that the progress of industry necessitates the acceleration of the construction of these stations. It has been decided to build a station on the Lukh river near peat bogs, so that the peat can be utilised as fuel. The power will be transmitted by high-tension lines to Nizhni-Novgorod, where a large motor-car factory, capable of producing 120,000 cars a year, is being constructed. The Chiatura manganese mines in Transcaucasia and sections of the Transcaucasian railway will be served by a large hydro-electric power station. In Leningrad three thermal stations are to be constructed in 1930. At present, one of the municipal stations is being extended. Leningrad will also be served by the huge Swir 180,000 kilowatt power station, the period of construction of which has been shortened. It is satisfactory to find that the increase in the electricity output is greater even than the increase in the number of stations under construction. The capital invested

in these undertakings during the current year is seventy million pounds.

AT the recent meeting of the British Association in South Africa, the general committee, learning with great regret that Dr. F. E. Smith would find it necessary to vacate the office of general secretary during the present winter, empowered the Council to appoint an acting general secretary during the period between the present month and the meeting of the Association at Bristol next year. The Council has now appointed Prof. F. J. M. Stratton, professor of astrophysics in the University of Cambridge, to this office.

SPECIAL free facilities are being offered at the cinema in the Imperial Institute, South Kensington, S.W.7, where an interesting programme of films of historical and general interest has been arranged for the Christmas holidays. The programme includes "The Epic of Everest", the official film of the Everest Expedition (Dec. 22–28); "Outposts of Empire", Hong-Kong, Palestine, Gibraltar, Malta, Fiji (Dec. 29–Jan. 1); "With Captain Scott in the Antarctic", the official kinematograph record made by Herbert Ponting of the story of Capt. Scott's immortal journey to the South Pole (Jan. 2–Jan. 4); "Palaver", a film depicting the life of a district officer in Nigeria, in which the native parts are played by the Aura and Angas tribes (Jan. 5–Jan. 11); "The History of Electricity"; "The Making of a Lead Pencil"; and "Denizens of the Garden" (Jan. 19–22). There are four sessions daily, at 10.15 A.M., 11.35 A.M., 2.15 P.M., and 3.35 P.M., and two performances on Sundays at 2.45 P.M. and 4.15 P.M.

BY courtesy of the president and council of the Linnean Society, a general meeting of British botanists will be held at the Society's rooms, Burlington House, Piccadilly, W.1, at 3 P.M. on Jan. 10, when the chairman of the executive committee of the Fifth International Botanical Congress, to be held at Cambridge on Aug. 16–23 next, will report the progress made in organising the Congress. All interested in the matter are invited to attend.

Two volumes from "The Thinkers' Library", published by Messrs. Watts and Co. at 1*s.* net each, have reached us. One is "A Short History of the World", by H. G. Wells (pp. x + 310), and the other is "On Liberty", by John Stuart Mill (pp. xiii + 144). No 'Thinker' should live in one little truth-tight compartment, studying the Arachnidæ, for example, until he behaves like a spider. To keep in perspective one needs a more general outlook, and works of reference are not so portable that one can take an encyclopædia to a dentist's waiting-room for temporary refreshment. So we have this little library, with Rodin's *Le Penseur* for its badge. Mr. Wells's "History" is a little disconcerting when we read that Solomon's Temple could be put inside a parish church. In any event, as a master of the art of synopsis, he has not been equalled by any writer in the English language.

Our Astronomical Column.

Naked-eye Sunspot.—The prevalence of mist or fog at the time of a large sunspot usually results in the discovery of such a spot by a number of people previously unaware of its appearance, or of the frequency of large spots at times of maxima of the 11-year solar cycle. The large spot which crossed the disc on Dec. 10–22 is a case in point. The big circular spot (area 1000 millionths of the hemisphere), together with its cluster of followers, constitutes one of the largest groups of 1929, but it is only about two-thirds the size of the largest groups of the present cycle. The meridian (long. 345°) passing through the centre of the group shows considerable disturbance; there is a small spot in lat. 20° N.; a small group in lat. 13° N.; whilst a long stream (area about 900 millionths) lies in lat. 3° S. The Greenwich magnetograph traces for Dec. 16 are disturbed, the range in declination amounting to 35′ between 18^h and 20^h. The table below follows from that which appeared in our issue of Dec. 7, p. 888.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
17	Dec. 10–22	Dec. 16·5	6° N.	1500
18	Dec. 10–22	Dec. 16·7	3° S.	900

Motions of the Planetary Nebulæ.—Prof. C. D. Perrine discusses the nature and motion of the planetary nebulæ in *Astr. Nach.*, No. 5670. He uses the photographs of the objects and their spectra obtained at the Lick Observatory by Prof. Campbell, assisted by Drs. Moore, Wright, and Curtis. He thinks that internal motion, both of a radial and a rotational character, is the key to many of the anomalies noted by them. Some of the nebulæ are concluded to be expanding and some contracting. The latter appear to have a harder and more definite outline. The assumption that most of the shift of the spectral lines arises from internal motion gets rid of the puzzle presented by the high radial velocities of these objects; if the motion is internal the system as a whole may not have a high velocity with respect to the galactic system.

A graph is given of radial velocities grouped in relation to the angular diameter of the nebulæ. The velocities are found to vary inversely as the fourth root of the diameters. This law is taken as strong confirmation of the conclusion that the velocities are internal, for such a relation is then explicable on gravitational grounds, but no reason can be imagined for the velocities of the systems in space following such a law.

Prof. Perrine adopts as the most plausible hypothesis the view that the planetary nebulæ are the results of former outbursts of novæ, and that they have now attained an approximately stable condition.

Reported New Comet.—*Harvard Announcement Card* No. 100 states that Mr. E. F. Carpenter found on Nov. 12 an image of a comet on a plate that he had exposed at Tucson, Arizona, Nov. 2·280 U.T., R.A. 2^h 25^m 2^s, N. Decl. 20° 8′ 57″, daily motion +14^s, −5′, magnitude, 16; length of tail, 30″. The direction of the motion was verified by the fact that the seeing was deteriorating during the exposure, and one end of the trail was fainter than the other. Dr. C. H. Smiley has deduced that the node is probably in the neighbourhood of 240° and the inclination small.

Mr. Carpenter has found another cometary image, also of magnitude 16, on a plate exposed by Mr. P. C. Keenan on June 17·240 U.T., 1928, R.A. 15^h 3^m 57^s, N. Decl. 2° 2′, daily motion 5·2^s, 0·2′ either E.N. or W.S. (*Publ. Astr. Soc. Pacific*, Oct. 1929).

Research Items.

Social Organisation in Africa.—Dr. Thurnwald concludes his survey of African social systems in *Africa* for October. The highest forms of social organisation in Africa are found in association with cattle and cultivation of the soil. Many crafts are practised in the home for the benefit of the family. Some callings are the monopoly of certain clans. Clans may either be equal or socially graded, while there is also gradation within the clan. In the larger units under a central authority the most diverse groups may exist side by side. Generally, the tribes which are engaged directly in procuring the means of existence are the most primitive. The higher organisation is based on the association of different tribes each specialising in an occupation. By this association, however, each tribe becomes more exclusive, as their livelihood depends more and more on the exchange of their products. Among tribes such as the herdsmen of East Africa, a graded society is directed by sacred princes, society being stratified upon agricultural clans and hunters. Among the herdsmen-farmers of South Africa, cattle-keeping is still the dominant factor. In the Sudan and West Africa the organisation is that of a stratified peasant-pastoral with three grades of freemen, dependents, and slaves. The final form to be distinguished is that of the net-like state uniting various races under a king—a type of state internally associated with sacred rites such as that of Abyssinia and Kaffa, with an aristocracy derived from cattle and horse herdsmen, great families with slaves, the use of the plough and professional craftsmen of various kinds, who are also recruited from aboriginal rulers and immigrants.

Sumeria and Oceania.—Dr. P. Rivet, following up his previous studies of the Oceanic group of languages in which he sought to show the influence the peoples of the Pacific had exercised on the Mediterranean and African worlds, now endeavours to trace a connexion between the Oceanic languages and Sumerian. He has published as No. 24 of the *Collection Linguistique* of La Société de Linguistique de Paris, a vocabulary which gives his identifications in Sumerian, Melanesian, Polynesian, Australian, Tasmanian, Indonesian, Mon-Khmer, Munda, etc. The work is entirely lexicographical and grammatical affinities have not yet been explored. The difficulty in the comparison of Sumerian and Oceanic vocabularies lies in the fact that the former are abstract, while the latter are concrete. There are also certain phonetic changes. Sumerian, for example, does not show the tendency to nasalisation which appears in the Oceanic languages, and especially Australian. There are many examples of borrowing between Munda and Sumerian which are explained as due to commercial relations between Euphrates and Indus three thousand years before our era. A certain number of roots common to the Sumerian and the Oceanic group also appear in Indo-European and Semitic. This is also due to borrowing. The hypothesis which is put forward in explanation is that there was a single linguistic family of which the centre of dispersal was south or south-eastern Asia, and this spread by stages from Japan, as shown by Ainu affinities, to Tasmania, and from the Mediterranean and Africa to America. This takes us back beyond the age of bronze, which at present bounds our knowledge of the Indo-European tongues, to a much earlier period five thousand years before our era, and to, at least, the neolithic age. The vocabulary remained stable in remarkable degree throughout this long period.

Increase of Elk in Sweden.—The European elk is strictly protected in Sweden, where the open season for shooting is restricted to four days. The result has been a rapid increase in numbers, so that during the four days' shooting this autumn, some 3500 animals were killed, against 3700 last year (*Daily Science News Bull.*, issued by Science Service, Washington, D.C.). While sportsmen and naturalists rejoice at the change in status of the elk, farmers and foresters are less favourably disposed to protection. Increasing numbers and competition for food have made the animals, formerly shy and elusive, extremely bold and occasionally ferocious. In certain parts of Sweden they have damaged crops and young trees, and in places not only have they refused to budge from fields and gardens when called upon, but also have actually attacked farmers protecting their own crops.

White-sided Dolphin in Scottish Waters.—Formerly the general opinion was that this species was rare in British seas. Records of strandings collected by Sir Sidney Harmer, however, indicated almost annual occurrences, and the observations of Charles Oldham during the last few years suggest that it is present in schools of considerable size (*Scottish Naturalist*, 1929, p. 133). Its range in place here would appear to centre about the northern North Sea, and the records are confined to the spring and summer months, so that this may be another example of a temporary influx from the Atlantic Ocean. It ought to be added, however, that a young specimen, received at the Royal Scottish Museum, was caught in the latitude of Buchan Ness about mid-November of this year.

Hay Rations for Dairy Cows.—The importance of making the best use of hay in the feeding of dairy cows is the subject of an article by R. Bontflour in the *Journal of the Ministry of Agriculture*, vol. 36, p. 707. A system of rationing is strongly advocated, and the economy, which will be of particular importance to the farmer in view of the shortage of supplies during the present winter, is convincingly shown to be of real benefit to the cow and to increase her yield of milk. The nutritional properties of hay vary considerably, a poor sample having only half the value of one of good quality. To obtain the best type of hay, early cutting is important, weathered hay if cut early being preferable to that got in under good conditions but cut late. Twenty pounds of hay a day is taken as the standard requirement for the maintenance of the average cow and for the sake of those whose supplies are insufficient to meet their needs, and who must use supplementary feeding stuffs, the equivalent ration of various substitutes are given. Of these sugar beet pulp and brewer's wet grains are specially recommended if purchase is necessary. However, it is pointed out that supplementary feeding may often be avoided if the hay is rationed and a pasture dressed with a hundredweight an acre of sulphate of ammonia in late January to secure an early bite. A cow allowed unlimited hay will consume more than she can digest, and a wastage of so much as one ton of hay per cow per winter may be accounted for in this way. It is equally important to ration hay fed in conjunction with concentrates or roots, for these may actually increase the cows' appetite for hay and decrease of milk yield will result from indigestion. As a conclusion a true story is related in which a prize for the higher milk yield was obtained by surreptitiously giving the opponent's cows an extra feed of hay.

Marine Hydrozoa of the Faroes.—Dr. P. L. Kramp gives a summary of all known hydroids from the Faroe plateau proper and the Faroe Bank in his "Marine Hydrozoa" (Zoology of the Faroes, Pedersens, Copenhagen, 1929). The recent investigations of 1925–27 have brought up considerable material which has, however, only added six species to the number previously known. Fifty-nine species are now known from the Faroe plateau proper, inside the 200 m. line. Three more species are added from the Faroe Bank. Some of the remarks on the distribution of the species are very interesting; for example, the capricious habit of *Clava squamata*, which occurs in some places abundantly and is absent from others which appear to afford exactly similar conditions, and *Dinamena pumila*, which only occurs when *Ascophyllum* is present, although it may grow also on certain species of *Fucus*. Maps and tables are given showing the distribution of the more important species found on the Faroe plateau, almost all of which occur on the British, Norwegian, or southern and western Icelandic coasts, and many being common to the Mediterranean and South European coasts. The evidence seems to show that the hydroid fauna of the Faroes is chiefly made up of species which have their main area of distribution in the more southerly regions, although there are arctic and boreal forms. The author explains that this is due to transportation by free swimming medusæ or of hydroids fixed to floating objects, or that the polyps can live in deeper water, so that the sub-marine ridges enable them to reach the Faroe plateau either from the north or from the south, and that in no case need we take into consideration the possibility of the survival from a time when the islands were more closely connected with other countries.

Non-Nucleated Blastospheres of a Spider.—Dr. E. Warren (*Annals Natal Mus.*, vol. 6, 1929) describes the incipient development of the eggs of three spiders (*Polystes natalius*) which were unable to produce eggs capable of full development. In one spider (*D*) the eggs were certainly, and in another (*C*) probably, unfertilised; in the third spider (*G*) the condition was doubtful. About 80 per cent of the eggs of spiders *D* and *C* shrivelled and died on the second day after laying—due to lack of resistance to desiccation—but the surviving eggs resisted desiccation in the normal manner. In the eggs of *D* no trace of formation of polar bodies could be detected, but a normal fertilisation membrane was formed in the eggs of all three spiders. The eggs of *D* underwent a certain progressive development; those of *C* exhibited at the time of laying a variable amount of development which progressed little further, the eggs of *G* appeared normal when laid and the central nucleus underwent mitosis, but there was complete inability to form a normal embryo. In the eggs of *C* and *D* no trace of mitosis was found. The cytoplasm of all three lots of eggs exhibited a marked activity, numerous well-defined bodies being produced which looked like cells except that they had no distinguishable nuclei. These bodies formed a perfect blastosphere—without a single nucleus being found in the epithelium—which flattened at one pole and produced by the proliferation of the non-nucleated masses a ventral plate. In the eggs of *G*, nerve ganglia were formed in a totally undifferentiated plasmodium.

New Varieties of Hops.—The twelfth report by Prof. E. S. Salmon, on the trials in 1928 of 102 new and commercial varieties of hops (*Journal of the Institute of Brewing*, **35**, 523; 1929), is of special interest in that those plants, originally raised in or selected from the Experimental Hop Garden at Wye College, are now sufficiently established at East Malling Research Station for their distinctive characteristics to be ascertained. The most outstanding features are the high yields of 20 cwt. or more to the acre obtained from 23 of the hops, and the high preservative qualities of certain of the new varieties. In particular, two of the latter gave values 1·52 and 1·21 per cent higher than that of the best hop obtainable in 1928, and there seems good grounds for believing that hops equal or superior in preservative value and flavour to the best American hops will be available for cultivation in England. In this connexion it is reassuring to learn that variety rather than soil or climate determines the brewing value of a hop. Investigations on the incidence of mosaic disease, which was high in 1928 though lower than in 1927, have shown that though many of the new varieties are themselves immune, they may act as 'carriers' of the virus, and so transmit the disease. Though this transmission has at present been demonstrated only by grafting, it is clear that it may take place rapidly in hop gardens by other means, and a number of formerly puzzling cases are thereby explained. A list of susceptible varieties is given. Observations of downy mildew confirmed the experience of previous years, namely, that a variety though severely attacked on its bines may be resistant on its cones, and conversely that severe attacks on the cones may occur while the bine remains healthy.

Bibliography of Tides.—A bibliography of tides for the years 1910–27 has been compiled by Prof. J. Proudman and published as *Bulletin* No. 12 of Section d'Oceanographie, Union Géodésique et Géophysique Internationale. The entries are chronologically arranged under ten headings. Only publications in a Latin or Teutonic language are included. Publications on the utilisation of tidal energy and ephemeral tide tables have been excluded.

New Zealand Earthquake of June 17, 1929.—Two preliminary reports on this interesting earthquake have recently been published, one by Messrs. H. T. Ferrar and L. I. Grange, the other by Mr. H. E. Fyfe (*N. Z. Jour. of Sci. and Tech.*, vol. 11, pp. 185-191, 192-197; 1929). The main centre of the earthquake appears to have been situated on the White Creek fault, which crosses the Buller River seven miles to the west of Murchison. The re-levelling of the district by the Public Works Department shows that the country on the east side of the fault has been uplifted. At a distance of nine miles from it, there is no appreciable change of level, but towards the fault the change increases though with some oscillations. At the fault, the east side has been raised 14 ft. 9 in., but, about 550 yards to the east of the fault, the uplift is 16 ft. 1 in. The course of the fault is marked by shattered ground and disturbed vegetation; trees lean over at all angles or are uprooted and split. The block on the west side of the fault has not yet been re-levelled.

Spectra of Xenon and Arsenic.—The November number of the *Journal of Research*, published by the Bureau of Standards at Washington, contains papers by W. F. Meggers, T. L. de Bruin, and C. J. Humphreys, on the arc spectra of xenon and of arsenic, both of which had been previously only incompletely described. Xenon has been studied in special detail, and is likely to furnish lines which are even better suited for standards of wave-length than those of krypton. The majority of the lines lying between 3000 A. and 10,000 A. which have been measured—three hundred odd—have been fitted into a term scheme generally similar to those already known for the lighter inert gases, but there are certain differences consequent on the high atomic number of xenon which

will almost certainly be found to an even greater extent in the spectrum of radium emanation, which is now under investigation. The analysis of the arsenic spectrum is less complete, and has been extended so far only to the infra-red and ultra-violet lines, new lines which have been found in the visible region not being included. These papers have been made very readable by the inclusion of histories of the older work on the elements in question, and contain good large-scale reproductions of the spectra.

Structural Stresses.—The Engineering Experimental Station of the University of Illinois has for some time been determining the stresses in structures of forms too complicated to admit of mathematical treatment by means of tests on models made of 'pottery plaster', which is plaster of Paris with an addition which delays its setting. *Bulletin* No. 195 of the Station contains an account of the tests of beams of circular, rectangular, triangular, and H section bent into U shape, carried out by Profs. F. B. Seely and R. V. James. In the first instance the legs of the U were forced together until the beam broke at the bend, then the two straight lengths were supported at the ends and loaded in the middle until the beam again broke. The results obtained show that the plaster model gives trustworthy information as to the maximum stress a structure will stand if five to ten tests are made and the mean taken. The H section beams broke at the abrupt change of section unless provided with a fillet of at least $\frac{1}{2}$ inch radius.

Preparation of Telluric Acid.—Several methods of oxidising tellurium or its dioxide to telluric acid have been described. A new one is given by Mathers and Bradbury in the November number of the *Journal of the American Chemical Society*. Tellurium dioxide is mixed with five equivalents of calcium hydroxide and heated at 975° for one hour exposed to air. Complete oxidation was very nearly attained. The percentage of oxidation was smaller at lower temperatures or with less calcium hydroxide. The calcium tellurate was treated with an excess of concentrated nitric acid, whereby soluble calcium nitrate and insoluble telluric acid were formed. This telluric acid, after filtration or decantation, was dissolved in water and crystallised until pure.

Enantiomorphism in Organic Compounds.—The October number of the *Journal of the Chemical Society* contains an important paper by John Read, I. G. M. Campbell, and T. V. Barker, on the optically active diphenylhydroxyethylamines and isohydrobenzoins. The authors discovered that crystals of pure *d*- and *l*-isohydrobenzoin, when deposited from ethyl acetate, exhibit characteristic hemihedral facets; when chloroform is used as solvent, however, the distinctive facets are not developed. Pure *dl*-isohydrobenzoin, when crystallised from ethyl acetate, separates as a conglomerate of enantiomorphously related crystals, composed of *d*- and *l*-isohydrobenzoin respectively; but the crystals deposited from chloroform are morphologically indistinguishable from one another so far as plane faces are concerned. The latter crystals, however, have been shown by polarimetric observation to be also of two kinds, consisting again of the pure *d*- and *l*- forms; moreover, despite the absence of plane hemihedral facets, the two sorts of crystals can be segregated through the circumstance that either the right or the left side of each crystal displays a marked tendency to degenerate into curved boundaries. This diagnosis by means of curved surfaces is entirely novel, and is of great interest in connexion with the so-called 'Pasteur principle', namely, the establishment of molecular enantiomorphism from a study of crystal form. The authors point out that this principle cannot be accepted as generally true, for there is nothing in the undoubted enantiomorphism of structure of *d*- and *l*-isohydrobenzoin crystals which categorically demands plane-faced boundaries, still less facets indicating right- or left-handedness. At the present time, the only question which can be raised is that of the frequency with which enantiomorphism of structure unfolds itself on the surface. Enantiomorphous hemihedrism among organic compounds is a good deal rarer than is commonly supposed, since in many cases it stands revealed only after repeated attempts at crystallisation, possibly with changes of solvent.

Hydraulic Pneumatic Engineering.—The *Journal of the Royal Society of Arts* for Nov. 29, 1929, contains a paper by Mr. J. O. Boving on new developments in hydraulic pneumatic engineering, in which particulars are given of many interesting applications of hydrautomats in which falling water is used for compressing or rarefying air and for raising water. Simple forms of hydraulic air compressors have been built for centuries in the Vosges and Pyrenees for providing air for forges and the air lift pump is in common use. Research work, however, has led to great improvements in such apparatus and many installations are now in use for irrigation and other purposes. One compressor plant described is at Alston, Cumberland, where there is an available head of 180 feet. The falling water is led to a steel separator tank about 400 feet below the top of the intake pipe in an old mine shaft from whence it again rises to a tail-race. The entrained air becomes compressed to about 90 lb. per sq. in. and is used for drilling, etc. A typical plant lifting water from a drainage canal is that at Bambanwala on the Upper Chenab Canal, Punjab, where a syphon rarefier works in conjunction with a continuous vacuum lifter which drains the town of Bambanwala. Other installations described were those on the Rio Ebro in Spain, and at a tin mine in Nigeria. "There is", said Mr. Boving, "a wide field for applying the ideas to other uses, not yet fully explored."

Alternating Current Potentiometers.—Dr. C. V. Drysdale read a paper to the Institution of Electrical Engineers on Dec. 6, giving an historical account of the evolution of the a.c. potentiometer and describing some of its many practical applications. He pointed out that no department of electrical testing involves such difficulties and such costly equipment as that of accurate a.c. measurements. Most of the instruments suitable for these measurements have a very limited range, owing to the fact that their deflections obey a square law. The ranges to be covered vary from a few millivolts to hundreds of thousands of volts and from milliamperes to thousands of amperes. As polyphase measurements have also to be made, special wattmeters have to be used for power and phase measurements. The cost of suitable apparatus to make all these measurements accurately runs to thousands of pounds and is beyond the means of all but the wealthiest factories. The direct current potentiometer first suggested in practical form by Sir Ambrose Fleming so far back as 1885 is the most universally used apparatus for d.c. measurements, and so many attempts were made to construct an a.c. instrument which could fulfil the same functions. One of the best of these instruments is the Drysdale a.c. potentiometer. It is particularly useful for testing wattmeters and ordinary supply watt-hour meters. It can also be used for measuring the frequency of alternating currents and the magnetic fields which they produce. These instruments are much in demand in countries where facilities for obtaining special instruments are limited, but they are often in general use even in well-equipped laboratories.

Modern Mining Explosives.

DR. WILLIAM CULLEN, who took the presidency of the Institution of Mining and Metallurgy on Oct. 17 last, chose for his presidential address the subject of mining explosives, this being one with which the greater part of his life's work has been identified. The address, therefore, constitutes an exceedingly valuable summary of the present position of the explosives industry; it is so rich in material that it is practically impossible to give an abstract of it which will do anything like justice to the large amount of matter it represents, there being practically no aspect of explosives with which Dr. Cullen has not dealt.

Necessarily, Dr. Cullen devotes considerable attention to the use of nitro-glycerine and its products, which are used more extensively than any other mining explosive throughout the world to-day. He points out the dangers attending the handling of explosives in which the nitro-glycerine is frozen, and explains how of recent years this difficulty has been got over, there being two methods in use to-day. In one the glycerine before nitration is polymerised; the nitrated polymerised glycerine acts like ordinary nitro-glycerine in all respects except that it does not freeze. The second method consists in replacing nitro-glycerine by dinitroglycol, which again behaves in all respects like nitro-glycerine except that it is not liable to freeze in winter. Explosives in which one or other of these products replaces nitro-glycerine to a sufficient extent to prevent freezing are generally spoken of as low freezing explosives and are used in all circumstances where ordinary nitro-glycerine explosives might be liable to freeze.

Dr. Cullen deals briefly with liquid oxygen explosives, but would scarcely appear to do them justice; they are used extensively in some parts of the Continent and are also used in open-cast work in Great Britain, as Dr. Cullen indicates; he states, however, that their use is attended with an economy of about 10 per cent, whereas some of the most recent authoritative statements on the subject show an economy of 30-50 per cent.

As an all-round explosive, Dr. Cullen appears to favour explosives consisting essentially of nitrate of ammonia with a certain definite proportion of nitro-glycerine. He points out, however, that in coal mining special types of explosives must be employed because of the danger of initiating explosions of fire-damp or coal dust. It has long been known that gunpowder, for example, is exceedingly dangerous in this respect both because it gives a fairly hot flame and also because the flame is one of long duration. The latter consideration is a very important one, and in connexion with this matter Dr. Cullen points out that the ordinary mercury fulminate detonator seems to be incapable of igniting firedamp, whereas the more modern tetral detonator with lead azide primer contained in an aluminium tube will always explode a mixture of firedamp and air.

Dr. Cullen is a keen advocate for the simplification of the explosives industry; for example, he points out that there are at the moment no less than 71 explosives on the British 'permitted' list, whereas probably a dozen would be sufficient, and that standardisation is here clearly indicated as a means of lowering the cost of such explosives without in any way diminishing their efficiency or safety.

It may perhaps be of interest to add that Dr. Cullen's address concludes with a reference to the interchange of technical information concerning explosives that is in existence between Great Britain and the United States of America, and in this connexion he refers to the recent award of the medal of the Institution of Mining Engineers to Mr. George S. Rice, Chief Mining Engineer of the U.S. Bureau of Mines. He points out that with European countries relations are cordial but are not so accurately defined as they are with the United States. It is surely not too much to hope that before very long the question of safety in mines, in which a proper understanding of mining explosives must always play a leading part, will be looked upon and treated as an international question, and that definite arrangements will be made with all countries in which the mining industry occupies a prominent position to pool all information tending to safety, thus avoiding needless duplication of effort and expenditure and directing research along the lines where it will produce the maximum degree of usefulness to mankind.

Low Temperature Carbonisation in Power Station Practice.

THE Institution of Electrical Engineers arranged a discussion on Nov. 21 on the low temperature carbonisation of fuel in combination with the generation of electricity. Prof. P. Rosin dealt with German practice, S. McEwen with American, and E. H. Smythe and E. G. Weekes with English practice. As all these speakers have had ample opportunity of familiarising themselves with the problem, their opinions deserve close attention.

Prof. Rosin says that in Germany the original aim of carbonising bituminous coal for the sake of the tar and oil has met with disillusionment, and the principal object is now the production of a smokeless domestic fuel from fine coal slacks, while the utilisation of the gas receives increasing attention. Indeed, the only large low temperature plant working economically on coal is the K.S.G. plant at Karnap—a unit of which is now installed at a London gasworks.

In power station practice the size of the coke product is unimportant, the available boiler plant being capable of consuming anything from dust to lumps. No value can therefore be assigned to the coke in excess of that of cheap low-grade boiler slacks—the cheapest grade of coal. It is therefore much more difficult to couple precarbonisation of coal with power production than to make economical domestic fuel, which commands the highest price in the market. The capital costs must be very low and the yields of tar and gas high. In Germany, Rosin says these conditions cannot be realised, and "low temperature plants using pit coal . . . offer no prospect of remunerative operation at present". With brown coal the position is different because the raw material, got without mining, is very cheap and the tar more valuable than the coal. Much of this tar is now being converted into motor spirit, 200,000 tons of which will be made this year. Nevertheless, the by-products are regarded as an unstable item of revenue, and the revenue from the sale of electricity should be regarded as the basis of any successful enterprise.

S. McEwen, speaking of American experience, voiced similar views on the economics of power station carbonisation. Owing to the low value of the coke for steam raising, it is essential to reduce the capital and labour costs to a minimum. It was with this idea in view that the process of carbonising coal dust while falling through a vertical retort was developed by McEwen and Runge. The product

can be used directly as pulverised boiler fuel. After various technical difficulties had been overcome, it came to be realised that the gas should be utilised for town gas supply in order to give the process a chance of economic success—the gas being the most valuable product. This has necessitated embarking upon further modifications of the process so as to obtain a gas rich enough for distribution. This last stage in the development of the process is now in process of development.

The two British workers described the 'Babcock' process, which has been the subject of experiment for ten years at the Dunstan station of the Newcastle Electric Supply Co. In this case a Northumberland coal slack is subjected to heat by direct contact of a mixture of superheated steam and combustion products on its way to the grate of a stoker. As this plant is now in its third year of operation, no doubt is felt as to its practicability, and designs have been prepared for a unit capable of dealing with 160 tons of coal per day, which will be commensurate with modern boiler practice. From 1 ton of coal costing 11*s.* it is said that by-products valued at 8*s.* 11*d.* are obtained, and considerable optimism is displayed as to the future of the combination.

In this respect, these opinions are scarcely in accord with those of Rosin and McEwen. The former expresses the exact converse, while the latter regards the evaluation of the gas as a key to financial success. It may be remembered that the existing producers at the moment find coal tar oils an embarrassing drug on the market. It will therefore be wise to suspend judgment as to the future of pre-carbonisation of boiler fuel. No appreciable reduction, if any, of the cost of generation, is to be anticipated. There would be a gain in the abolition of smoke by the power station and better conservation of the chemical values of the coal. H. J. H.

Work of the Canadian School of Prehistory in France in 1929.

FOR four months, July to October inclusive, the Canadian School of Prehistory has been carrying on excavations in the classic hillside of Combe-Capelle, in the beautiful valley of the Couze—a tributary of the Dordogne, in which many *gisements* occur. It was there that some twenty years ago *Homo Aurignaciensis hauseri*, Klaatsch, was found. Mousterian, Aurignacian, and Solutrean materials, implements, engravings, etc., have also been found there, whilst a certain *terrasse* below the Plateau Ruffet appears to contain so many typical Acheulean hand-axes—*coups de poing*—that an Acheulean horizon seems indicated.

This is the fourth year of work by the Canadian School at Combe-Capelle, and one main *fouille* has yielded very interesting and practically unique types of tools of flint deserving special notice. Four collections of the very best found during this year's explorations were prepared for (1) The Musée national des Eyzies, Dordogne, headquarters of the School; (2) St. Germain-en-Laye; (3) Institut de Paléontologie Humaine; and (4) Le Musée Cartailhac, Université de Toulouse, Haute-Garonne.

Besides these collections, which were labelled carefully as to precise geological strata from which they came, from Beds No. I., No. II., No. III., No. IV., occurring at Combe-Capelle, of which some twenty-five cases were shipped to Canada after inspection by the Beaux-Arts of Paris, other series were obtained from (1) Le Moustier (Upper Cave), and from the Émile Bompson property near the classic *abri* of that name. Four district beds, older than the oldest Mousterian known at Le Moustier Abri up to last year, were searched, and valuable and new information gathered of prehistoric value.

By request, the Canadian School was engaged in two other sites during 1929, namely, at Gavaudun, la Grotte du Moulin du Milieu, Lot-et-Garonne, where new facts were recorded of geological, palæontological, and archæological significance; (2) at Le Ruth, in the Vézère Valley, close to some old Mousterian *atelier*, which yielded some typical Mousterian implements besides teeth and bones of reindeer, lion, great stag, bison, horse, and claw of an eagle.

The School also visited an Azilian-Tardenoisian site near Sauveterre Lalémance (Lot), where a phase of these two periods seems to give some foundation to M. Coulonges, digging there, in establishing a sauveterrian phase of the uppermost palæolithic of that region. Geometrical pieces, microliths in large numbers, occur, associated with an abundant fauna, all of which will no doubt soon be described. The caves, rock shelters, and museums of the Dordogne or Périgord District were visited by the director and students of the (Canadian) School of Prehistory, every facility being afforded by M. Peyrony, administrator of the Beaux-Arts, to study the paintings, drawings, sculptures, engravings, and industries of the different ages represented in that remarkable locality. Les Eyzies is the European headquarters of the School, and a few days were spent by some members of the School in the Ariège Caves, in the Grimaldi Caves of Italy, and in the Museums of Natural History in Toulouse and Marseilles, where excellent collections in prehistory are housed to advantage.

The School's record of finds in France, Italy, England, and Holland have enabled it during 1929 to furnish the University of Toronto, that of Alberta (Edmonton), of Saskatchewan (Saskatoon), and of Manitoba (Winnipeg) with systematic series covering most of the periods in prehistory of the old and of the new Stone Age. The headquarters of the School in Canada is in Ottawa, Laboratory of Geology and Palæontology, Elgin Annex, where the director of the School has his office. H. M. AMI.

The Biblical Manna.[1]

THERE has always existed among scientific workers a wide divergence of opinion as to the true nature and origin of the manna, believed to have fallen from heaven to provide food for the Israelites in the Sinai desert during the Exodus from Egypt. Some authors considered the manna to be a desert lichen, *Lecanora esculenta* Nees, while others connected it with desert shrubs of the genus *Tamarix* and considered it to be either a physiological secretion of the plant, or its sap flowing from the wounds caused by insects. In order to solve this problem, the Hebrew University in Jerusalem organised in 1927 a small expedition to the Sinai Peninsula, and the leaders of that expedition, Dr. F. S. Bodenheimer and Dr. O. Theodor, have just published a very interesting account of their investigations.

The expedition visited some classical localities where manna was recorded. In the course of investigations,

[1] Ergebnisse der Sinai-Expedition 1927 der Hebraischen Universität, Jerusalem. Pp. 143+24 tafeln. (Leipzig: J. C. Hinrichs'sche Buchhandlung, 1929.)

it was established beyond doubt that the appearance of manna is a phenomenon well known in other countries under the name of 'honey-dew', which is a sweet excretion of plant-lice (Aphidæ) and scale-insects (Coccidæ). Two scale insects mainly responsible for the production of manna were found, namely, *Trabutina mannipara*, Ehrenb., occurring in the lowlands, and *Najacoccus serpentinus* var. *minor* Green, which replaces the former in the mountains. Two other Hemipterous insects, *Euscelis decoratus* Haupt and *Opsius jucundus* Leth., also produce manna, but to a lesser extent. All these insects live on *Tamarix nilotica* var. *mannifera* Ehrenb.; no manna was observed on other species of *Tamarix*, a fact probably due to some physiological peculiarities of the former. The authors observed the actual excretion by the insects of drops of clear sweet fluid, and proved by experiments that the fluid is ingested by the insects from the vessels of the phloem. When in an experiment a twig bearing the insects was placed in water, and the bark was cut below the insects, the production of manna continued in a normal manner, but it stopped as soon as the flow of carbohydrate solution from the leaves was interrupted by cutting off the bark above the insects. The dry desert climate of Sinai causes the syrup-like fluid excretion to crystallise, and the whitish grains thus produced, which cover the branches or fall to the ground underneath them, constitute the true manna of the Bible.

A chemical analysis of the manna demonstrated the presence of cane sugar, glucose, fructose, and saccharose; pectines were also found, but there was no trace of proteins.

Detailed descriptions of the manna insects are given in the report, which includes very good photographs of various stages of the production of the manna. Notes on the course of the expedition and on the fauna of the Peninsula of Sinai in general provide very interesting reading on that still practically unexplored country.

Fauna of the Batu Caves.

THE Batu Caves, near Selangor, were discovered in 1879, and the general character of the caves and their fauna was made known in 1898 by H. N. Ridley, and subsequent faunal records were made by Annandale and others. Mr. and Mrs. Cedric Dover have recently explored the caves, the total length of which is about 2500 feet, and their collection is the subject of a series of papers in the *Journal of the Federated Malay States Museums* (vol. 14, 1929).

The animals now reported upon include Mollusca, Crustacea, Nematoda (a new species of *Dorylaimus*), Arachnida, and seven orders of insects. Of the four molluscs, all gastropods, the genus *Opeas* was common throughout the cave, especially on damp boulders and on the walls, and both the species found (described as new) have eyes in which the pigment is small in amount or absent. Two isopod Crustacea are recorded—*Armadillo intermixtus* and *Philoscia dobakholi*—the latter, first described in 1924 from the Siju Cave in Assam, has "somewhat imperfect" eyes and a light colour.

The late G. O. Sars has given a detailed description of a new species of *Parabathynella* taken from a small pool about 900 feet from the entrance to the cave. These examples have seven pairs of well-developed legs and a rudimentary eighth pair, as contrasted with only five pairs of legs in the European specimens of *P. stygia* in which the three posterior trunk segments have no limbs—probably owing to their immature condition. Prof. Sars did not accept Dr. Calman's view that the Bathynellacea are Syncarida; he placed them in the division Anomostraca of the Malacostraca, and regarded them as "very primitive forms, apparently constituting the still living remains of an antediluvian fauna". Their primitive characters include the uniform segmentation of the body, the sharp definition of the first segment of the trunk, and their primitive limbs, and it is suggested that the Bathynellacea are the predecessors of the Amphipoda.

The Arachnida include a Pedipalp, spiders of four genera, and a new species of the tick *Ornithodorus*. Among the insects recorded are two genera of blattids, a strongly pigmented new species of *Gryllotalpa* (the first mole-cricket to be found in a cave), an earwig, a Myrmeleonid, and five species of Microlepidoptera, one of which, a *Tinea*, is common in the cave and its larvæ are abundant in the bat guano. Of the ten species of Diptera collected, none shows any modifications for cave life. Two Reduviid bugs are recorded and a dozen beetles—none markedly modified for a cavernicolous habit. The discovery of many larvæ of beetles in the cave indicates that some at least of these beetles have found congenial conditions and are firmly established there.

University and Educational Intelligence.

LONDON.—The title of emeritus professor has been conferred on Dr. E. A. Gardner on his retirement from the Yates chair of archæology at University College, and on Dr. F. W. Oliver on his retirement from the Quain chair of botany at University College.

The following doctorates have been conferred: D.Sc. in chemistry on Mr. J. Bardhan (Imperial College—Royal College of Science), for a thesis entitled "I. The Chemistry of Balbiano's Acid; II. The Action of Cyanoacetamide with β-diketones"; Mr. K. Krishnamurti (University College), for a thesis entitled "Investigations on the Scattering of Light in Colloidal Solutions and Gels"; Mr. F. G. Mann (Battersea Polytechnic), for a thesis entitled "The Complex Metallic Salts of the Aliphatic Polyamines". D.Sc. in zoology on Mr. William Rowan (University College), for a thesis entitled "Experiments in Migration, including an Investigation of the Sexual Rhythm and Histology of the Gonads in Birds". D.Sc. in geography on Miss E. G. R. Taylor, for a thesis entitled "Studies in Tudor Geography, 1500–1583".

PORTSMOUTH Municipal College sends us a booklet issued on the occasion of the visit of H.R.H. Prince Arthur of Connaught on Dec. 9 in connexion with an exhibition commemorating the twenty-first anniversary of the opening if the college. Erected, equipped, and maintained by the Portsmouth City Education Authority, it serves the higher educational needs of a wide area surrounding the city, including the Isle of Wight and parts of Hampshire and West Sussex, whence come twenty per cent of the technical college students. It comprises departments of science, arts, technology (mechanical, civil, electrical, marine, motor, and other branches of engineering, building trades and pharmacy), commerce and domestic science, and, in addition, a school of art and a training college, affiliated to the University of Reading, for women teachers. It has thus, as pointed out in a foreword by the chairman of the governing body, the potential constituents of a university college. The work includes, on the technical college side, full-time academic courses leading to degrees of the University of London in arts, pure science, engineering, etc., and, more recently, in pharmacy and a wide range of other courses both full-time and part-time. The number of full-time students in this part of the College has increased from 66 to 507. The number of training college students has increased from 180 to 215.

COURSES in anthropology announced for the coming session in the University of Paris as usual cover a wide range, both in general subjects and in departmental studies. For the diploma and certificate in ethnology, M. Mauss lectures on descriptive ethnography, M. M. Cohen on descriptive linguistics, M. Rivet on physical anthropology, and L'Abbé Breuil on "Préhistoire exotique". There are also special courses on the ethnography and linguistics of Africa and further Asia, zoological and biological anthropology, quaternary geology and palæontology, and the psycho-physiology of man and the anthropoids. Practical instruction in each course is given in museums. Courses given at the constituent bodies of the University are as usual grouped under ethnography, sociology, human geography, prehistoric archæology, linguistics, and phonetics, physical anthropology and palæontology. The course in linguistics is specially varied, and the lectures have obviously been arranged with the requirements of French colonial administration in view. They include Annamese, Siamese, Cambodian, Amharic, Lao, Malay, Malagasy, the languages of Modern India, and Arabic. Among the courses in ethnography may be noted one which will deal with the folklore of medieval western Europe and the formation of the Ossianic cycle from popular legend (M. Marx), and one by M. Mauss on the belief in the efficacy of the spell in Australia and the relation of myth and rite in New Guinea. The civilisation of Central America and Peru will be dealt with by M. Raynaud, and M. Cabaton covers the Malay Peninsula and Indo-China.

THE Rhodes scholarships statement for 1928–29 shows that of 181 scholars in residence, namely, 96 from within the British Commonwealth and 85 from the United States of America, 58 were pursuing studies in law, 34 in natural science and medicine, 25 in English literature, 19 in philosophy, politics, and economics, 10 in Lit. Hum., 8 in mathematics, 7 in economics, and 10 in other schools. It will be noticed that a large proportion (32 per cent) of the scholars elected to study law. Moreover, this preference seems to have been most marked among the more brilliant, and especially so among the Americans. Seven out of twelve and seven out of thirteen who gained, respectively, first and second class honours, did so in the school of jurisprudence, the remainder being distributed as follows: natural science 5, modern history 3, philosophy, politics, and economics 2, and English 1. Of the eight American scholars who took firsts, six were in the school of jurisprudence. Most of the higher degrees and first and second class honours were won by scholars from the United States, as was only to be expected, having regard to the wealth of academic resources and the extent of the field of selection in that country as compared with those in the British Empire overseas. The statement includes interesting notes *de mortuis* and particulars of honours and appointments obtained by former scholars, and of new books published by scholars. A former German Rhodes scholar is actively and prominently engaged in political life in Germany as a member of the Nationalist group in the Reichstag. A notable event of the year was a gathering in Oxford last July of old Rhodes scholars to celebrate the twenty-fifth anniversary of the inauguration of the scholarships. The celebrations lasted from July 4 until July 11. Old Rhodes scholars to the number of 190, 99 of whom were accompanied by their wives, were present. The central event was a dinner in Rhodes House on July 5 (the seventy-sixth anniversary of the birth of Cecil Rhodes), at which H.R.H. the Prince of Wales was present, with Mr. Stanley Baldwin in the chair.

Calendar of Patent Records.

December 28, 1871.—Antonio Meucci is an Italian claimant to the invention of the telephone. Meucci settled in the United States in 1851, and worked at his invention for many years, an attempt being made to start a 'Teletrophone Company', though this did not attract more than a few dollars of public support. A caveat for the invention was lodged in the United States Patent Office on Dec. 28, 1871, but was not taken up and lapsed at the end of the following year. Bell's patent was applied for in 1876.

December 30, 1775.—John Arnold, the London watchmaker, invented the cylindrical helical form of balance-spring for chronometers and received a patent for the invention on Dec. 30, 1775. A watch with the new spring was sent to Greenwich for an official trial in 1779, and successfully withstood all tests for a period of 13 months. Its total error during this period was only 2½ minutes, whilst its daily rate never varied by more than 3 seconds.

December 30, 1797.—The self-acting hydraulic ram was first invented by Joseph Michel Montgolfier, the celebrated pioneer of ballooning, and patented in England in the name of Matthew Boulton on Dec. 30, 1797, the French patent not being granted to Montgolfier until six months later. The principle of the hydraulic ram had been first used for raising water by John Whitehurst of Derby, who sent a description of his apparatus to the Royal Society in 1770, detailing its application to a domestic water supply in which every time the tap was turned on and off in the kitchen a column of water was forced into a tank in the upper part of the house. The value of the apparatus for water-raising purposes was not recognised, however, until Montgolfier's invention.

December 31, 1562.—The first patent in the English records for a machine for the draining of mines was granted for twenty years to John Medley on Dec. 31, 1562. The grant recites that "in oure counties of Cornewall and Devon as in diverse other places of oure Realme of England there be diverse mynes as well of tynne leade and other mettall as of sea-cole whiche through the greate habundance of waters rysinge in the same are drowned and altogether unoccupied", and that Medley has made "an engyne or instrument for the draynynge of waters not heretofore used in this oure Realme". It was the dependence of the mining industry on adequate water-raising devices that led to the invention of the steam engine.

December 31, 1790.—From the sixteenth century onwards patents for invention were granted intermittently by the French kings, but the first legislative enactment in France came into force in 1791, the Decree of the Assembly having been passed on Dec. 31, 1790. The first patent under the new law was granted in July 1791, and thirty-four were sealed before the end of the year.

December 31, 1842.—In the early days of the semaphore railway signal, which was introduced in England about 1841, many suggestions were made for combining it with a lamp for night signalling. Rudolf Treutler, who obtained a Prussian patent for six years for his invention on Dec. 31, 1842, proposed to attach to the semaphore arm a series of small mirrors all disposed in such a manner that they reflected the light from a lamp straight down the railway track for all positions of the arm, and thus illuminated the arm so that it was visible at considerable range. The arrangement was first used in 1844 on the Breslau-Freiburg railway and was adopted on a number of the Saxon lines, where it remained in use for many years.

Societies and Academies.

LONDON.

Geological Society, Dec. 4.—**Edward Greenly**: Foliation in its relation to folding in the Mona Complex at Rhoscolyn (Anglesey). The major, minor, and minimum foldings (with their thrustings) have each given rise to a foliation and developed in chronological order. The relations of major to minor folding furnish an explanation of the fact that the major cross-foliation, unlike a slaty cleavage, fails to traverse the pelitic beds. The foliation of the plutonic intrusions, and the tremolite-schists, are products of the major movements. The principal metamorphism is independent of, and older than, the major and subsequent movements. Its foliation is developed along innumerable thrusts, but these are at angles so acute to the bedding that, especially when thrown into rapid isoclines, they easily escape notice. This is the true explanation of 'monoplanic schists'. The early foliation is really the regional metamorphism. But the thrusting to which it is due, unlike those of the three later series, can be referred to no visible folding. Accordingly, its disentanglement goes to confirm the hypothesis that recumbent folding exists, and is the dominant structure of the Mona Complex.—**H. P. Lewis**: The Avonian succession in the south of the Isle of Man. The rocks described occupy a 'key' position in relation to Carboniferous rocks of the Irish Sea area. They lie within a basin, which is partly tectonic, between the Port St. Mary-Arbory fault on the north-west, and the line of the Langness Ridge on the south-east. The lithological and palæontological divisions have been worked out.

Linnean Society, Dec. 5.—**Mrs. E. S. Grubb**: The biological station of Alto da Serra, São Paulo, Brazil. This station consists of about 150 acres on the summit of the Serra do Mar, between the town of São Paulo and the sea. Von Ihering, in 1909, when he was director of the São Paulo Museum, had his attention directed to the rich and interesting vegetation, and, obtaining a concession of land, began the organisation of the Biological Station, which, however, he was unable to carry on, and sold to the Government. In 1923 it again became attached to the Museum. A valuable feature of the area is that it comprises not only mountain forest, but also stretches of open marsh-land and grass vegetation, all alike subjected to extreme and continuous humidity. The chief point about the Station is that no interference is allowed: nothing is taken out and nothing planted, and no clearance beyond cutting paths through the virgin growth to facilitate research and exploration. It is the object of the Director both to retain the original vegetation so far as possible and to give what assistance he can in its investigation.

Optical Society, Dec. 12.—**J. Guild**: The insensitivity and personal equation errors of optical settings. The paper contains the results of observations on the insensitivity, that is, mean difference of the individual observations of a large series from the mean of the series, in the case of X-type graticles set on vertical lines. The influence of the following factors was investigated: (1) Thickness of cross-wires (best thickness subtends 60″-90″ at the eye); (2) angle between cross-wires (best angle about 45°); (3) field brightness; (4) pupillary aperture (ordinary illuminations and apertures of 0·5 mm. and upwards have little effect on the insensitivity). Observations were also made of the magnitude of the 'personal equation' error in such settings.

Physical Society, Dec. 13.—**J. H. Awbery** and **Ezer Griffiths**: Apparatus for determining the specific heat of a material in powder form. A calorimeter suitable for heavy powdered materials, such as dry clay, is described. It utilises the electrical method, and embodies a special form of stirrer suitable for these materials.—**W. Edwards Deming**: On the determination of the parameters in an empirical formula. Some cautions regarding the use of the method of least squares were recalled. The method recently mentioned by Awbery is compared with those of least squares and zero sum, from the practical point of view. The method of zero sum appears to be the quickest and its results to be well in accord with common sense judgment.—**N. S. Alexander**: The *J*-phenomenon in X-rays. A series of experiments has been carried out with the view of repeating so far as possible the work of Barkla and others on the *J*-phenomenon. The results obtained in no case provide any evidence for this phenomenon, and, considered in conjunction with the work of Dunbar, Worsnop, and Gaertner, they suggest that it has no real existence as an X-ray absorption effect.

DUBLIN.

Royal Dublin Society, Nov. 26.—**J. H. J. Poole**: The thermal instability of the earth's crust. It has already been shown (*Phil. Mag.*, March 1928) that the thermal history of the earth's crust depends on the fact that the melting point curve for the crustal materials is, almost certainly, steeper than their adiabatic curve in the fluid state. The present paper is an attempt to solve the problem more completely, assuming that the crust may be treated as a crystalline solid with a definite melting-point. The stability of a liquid layer in such a crust is investigated. Taking the rate of transference of heat from the liquid to the overlying solid as proportional to their difference of temperature, two simultaneous differential equations are obtained, giving the rates of upward motion of the bottom and the top of the liquid layer, respectively. These equations can be solved for the portion of the crust below the equilibrium position of the melting-point geotherm, where the loss of heat by conduction is sensibly zero, owing to the smallness of the temperature gradient. When the layer moves upwards sufficiently to lose heat by conduction through the upper solid, the equations can be solved approximately if numerical values are inserted. This process has been carried out, and the history of the postulated system investigated.—**T. Donnelly** and **J. Reilly**: Low temperature carbonisation of peat. Specimens of Irish peat were subjected to low temperature carbonisation under conditions which prevented any appreciable cracking of the tars, and preserved the wax and heavy oil. A yield of 16·6 per cent of tar was obtained from an air-dried black peat; this tar contained 5·4 per cent phenol; unidentified higher acids; 4·4 per cent of 'resinals', and 0·9 per cent of 'resamines'. The peat also yielded 22·6 lb. of acetic acid and 17·4 lb. of ammonium sulphate per ton. This is nearly twice the usual yield for these products. The yield of gas obtained is low (8·6 per cent by weight) and the quality poor, 42 per cent of carbon dioxide being present. Wax and bitumen are present in the peat to the extent of 10·5 per cent.—**J. Reilly, T. V. Creedon**, and **P. J. Drumm**: The nitration of substituted phenylbenzylamine derivatives.—**M. Grimes**: A study of two new species of bacteria belonging to the genus *Chromobacterium*. In the course of the bacteriological examination of 36 samples of surface water, bacteria belonging to the genus *Chromo-*

bacterium were isolated in 17 cases. These cultures represent two new species named respectively, *Chromobacterium hibernicum* and *Chromobacterium cohaerens*.

PARIS.

Academy of Sciences, Nov. 18.—**E. Mathias**: Contribution to the study of fulminating material. The serpentine forms.—**A. Bigot**: The dome-shaped ridges of the Cambrian of Carteret and the *Chlorellopsis* ridges.—**Charles Nicolle** and **Charles Anderson**: The Moroccan recurrent spirochætes of the *hispanicum* group are not separable into species. The spirochæte of Mansouria is proved to be recurrent in man. Only one group of spirochætes appears to be transmitted by ticks, *Sp. hispanicum*.—**G. Nicoladzé**: The characteristic points of a curve belonging to a continuous system.—**J. Favard**: Researches on convex curves.—**Georges Valiron**: Some properties of algebroid functions.—**Harald Bohr**: A problem of M. Borel.—**Gaston Julia**: A development of holomorph functions.—**Jacques Chokhate**: The polynome of Tchebycheff of the best approximation.—**Radu Badesco**: The distribution of singularities. The solution of a linear integral equation.—**Gr. C. Moisil**: The theorem of infinite groups.—**W. S. Fédoroff**: The growth of analytical functions and their differentials.—**Kourensky**: The most general case of integrability of the equations of motion of a solid body in a liquid.—**A. Lokchine**: The bending of an anisotropic beam.—**A. Danjon**: The periodic displacement of the pole.—**Pauthenier** and **Mallard**: Contribution to the study of the cylindrical field in ionised air at the ordinary pressure. The experimental control. The results predicted by theory and found experimentally are compared graphically.—**J. Peltier**: The localisation of flaws in shafting.—**P. Chevenard**: The thermal treatment of ferro-nickels with two constituents.—**René Delaplace**: The disappearance of hydrogen in Geissler tubes. If the tube is separated from the rest of the apparatus by a Dewar tube containing liquid air and this allowed to remain for 24 hours, in the tube thus freed from traces of water and mercury vapours hydrogen does not undergo irreversible contraction and no trace of carbon monoxide or of methane could be found. This negatives the suggestion that the dissociation of the internal wall of the glass tube may give rise to carbon compounds. This is attributed by the author to the fact that when the tube is perfectly dry there is little or no production of atomic hydrogen.—**Raymond Charonnat** and **Raymond Delaby**: A new product derived from pyramidon. Description of a product obtained by the reaction of pyramidon and perhydrol: empirically, its composition is a pyramidon dioxide.—**Georges Darzens**: Hexahydrophenylethyl alcohol and some of its derivatives.—**Marcel Faidutti**: Transpositions of ethylene oxides in the terpene series. Camphene and nopinene oxides, prepared by Prilejaieff's method, on distillation in the presence of silica or pumice powder, are really transposed into aldehydes. Zinc chloride also causes the same change.—**A. Grebel**: Variations of the temperature of spontaneous inflammation of hydrocarbons in admixture with various substances, as a function of the proportion of these different substances in the mixture. The mixtures studied were petrol and absolute alcohol, and ternary mixtures of petrol, absolute alcohol, and benzene. The effect of small additions of acetone and of aniline was also studied.—**E. Raguin**: Has the vermicular bundle of Zermatt its homologue in the geological structure of the Haute-Marienne?—**J. Thoulet**: Submarine mineral springs.—**Pierre Dangeard**: Some new algæ containing iodine. 120 species of marine algæ have been examined by a microchemical method for iodine.—**H. Labbe**, **Heim de Balsac**, and **R. Lerat**: The theosterols of cocoa. Estimations of the sterols in cocoa butter, and in the beans, germs, and husk. The fat extracted from the husks was very rich in sterols, about twenty times the amounts found in the butter extracted from the whole bean.—**Emile F. Terroine**: The preparation of artificial milks for raising cattle.—**André Mayer** and **Georges Nichita**: The water emitted by vaporisation and its relations with the respiratory exchanges in homeotherms. The ratio H_2O/CO_2.—**Loeper**, **André Lemaire**, and **Jean Patel**: A method of recording graphically the pressure of the cephalo-rachidian fluid.—**Fernand Mercier** and **Jean Régnier**: Lævorotatory cocaine and dextrorotatory pseudococaine: the comparative toxicity and different destruction by the animal organism.—**René Hazard**: Researches on the antagonism of the base tropine (tropanol) and of pilocarpine on the heart.—**Marcel Mascré** and **Maurice Herbain**: The influence of formaldehyde on the precipitation of the nitrogenous matters of urine by trichloracetic acid.—**E. Brumpt**: The evolutive cycle of *Schistosoma bovis* (*Bilharzia crassa*), a spontaneous infection of *Bullinus contortus* in Corsica.—**M. Belin**: The presence of antibodies in the pus of the fixation abcess.

VIENNA.

Academy of Sciences, Nov. 7.—**W. J. Müller** and **L. Holleck**: The theory of passivity phenomena (7). The anodic behaviour of copper in sulphuric acid electrolytes. The behaviour of the copper was tested under varying conditions of concentration of acid, of saturation of copper sulphate and of temperature. The equation previously found connecting initial current density and time of passivation was confirmed. The first formed layer is of copper sulphate pentahydrate. Afterwards this is transformed, as shown by polarised light.—**W. J. Müller** and **L. Holleck**: The theory of passivity phenomena (8). The anodic behaviour of zinc in sulphuric acid electrolytes. Zinc shows surface passivity, at first due to zinc sulphate heptahydrate. A secondary transformation sets in the more rapidly the weaker the sulphuric acid.—**W. J. Müller** and **K. Konopicky**: The theory of passivity phenomena (9). The passivity of lead in sulphuric acid and the contribution to the theory of the formation of the lead anode. Results were obtained by measuring the current-time curves of lead in accumulator acid at constant potential. The passivation time is very short corresponding to the difficultly soluble lead sulphate. Current-time curves were measured with the oscillograph. An increase of solubility is explained by the hydrolysis of quadrivalent lead going into solution.—**W. J. Müller** and **K. Konopicky** (10): The time law of self passivation.—**W. J. Müller** and **W. Manchu** (11): The anodic behaviour and passivity of iron in sodium sulphate solutions. An oxidised film forms on iron both in air and in air-saturated solutions, and very rapidly. This introduces a difficulty in the determination of the passivation time for iron.—**L. Moser** and **F. Siegmann**: The determination of indium and its separation from the monoxides and sesquioxides. Indium has little analytical resemblance to gallium. $In(OH)_3$ is practically insoluble and may be precipitated with ammonia. In_2S_3 is completely precipitated by hydrogen sulphide in acid solution and allows of a quantitative separation of indium from iron and aluminium. Zinc, nickel, and chromium are separated from indium by potassium cyanate, cobalt by potassium cyanide.—**N. Fröschl**, **J. Zellner**, and **H. Zak**: Synthetic experiments in the sugar group (1). Some derivatives of fructose and lactose. With hepta-acetyl-bromlactose there were obtained good crystallising acetyl-lactosides of menthol, glycol, etc.—**G. Machek**: The linear pentacene series (18). Two

isomeric dibromo-derivatives of the linear pentacenediquinone-5, 7, 12, 14.—**F. Lieben** and **G. Ehrlich**: The decomposition of glucose and fructose by *Bacillus coli*. Fructose is more rapidly attacked than glucose.

Nov. 14.—**M. Beier**: Results of a zoological expedition to the Ionian Islands and the Peloponnesus. (4) Myriopoda by **K. Attems**. (5) Reptilia, Amphibia, Orthoptera, Embidaria, and Scorpiones by **F. Werner**. —**J. Mayer**: The absolutely smallest discriminants of the biquadratic number-body.—**G. Nöbeling**: The theory of regular curves. The theory of universal assemblages. Remarks on a theorem by O. Schreier.

Nov. 21.—**W. Figdor**: The positive geotropism of the axial bulbs in *Gloriosa superba*.—**H. Pettersson**: The disappearance of radon in quartz capillary tubes during electrodeless discharge. To be compared with the disappearance of xenon in discharge tubes.—**S. Schneidt**: The electro-chemical behaviour of polonium in solutions of various hydrogen ion concentration. Polonium must be in the colloidal form in dilute solutions.—**M. Hoschtalek**: The conductivity on old and new rock-salt surfaces in damp air. The conductivity is first noticeable when the vapour pressure of the air is above 4·4 mm.—**K. W. F. Kohlrausch**: The calculation of chemical bonding forces from the frequencies of the Raman lines.—**A. Steuer**: The species of the Copepod genus *Acartia* in the Mediterranean province.

Official Publications Received.

BRITISH.

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1928–29. Pp. 30. (Aberdeen.)

Records of the Indian Museum. Vol. 31, Part 2, July. Pp. 81-159+plate 6. 2.12 rupees; 5*s*. Vol. 31, Part 3, September. Pp. 161-257+plates 7-11. 2.12 rupees; 5*s*. Vol. 30, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1928. Pp. xxvi. 7 annas; 9*d*. (Calcutta.)

Memoirs of the Indian Museum. Vol. 9, No. 3: A Revision of the Fissilabioidae (Cordulegasteridae, Petallidae and Petaluridae). Part 1: Cordulegasteridae. By Lieut.-Col. F. C. Fraser. Pp. 69-167+plates 9-12. (Calcutta.) 4 6 rupees; 7*s*. 6*d*.

FOREIGN.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 49: A New Index to Control Cable Endurance. By Taitiro Ogawa and Sigetake Suzuki. Pp. 243-258. 0.22 yen. No. 50: Air Flow through Suction Valve of Conical Seat. Part i: Experimental Research. By Keikiti Tanaka. Pp. 259-360+plates 13-16. 1.17 sen. (Tôkyô: Koseikai Publishing House.)

Regenwaarnemingen in Nederlandsch-Indië. Vijftigste Jahrgang, 1928. Pp. ii+133. (Weltevreden: Landsdrukkerij.)

Proceedings of the Imperial Academy. Vol. 5, No. 8, October. Pp. xvii-xx+307-402. (Tokyo.)

Diary of Societies.

SATURDAY, DECEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (1): The Elementary Use of Nature.

MONDAY, DECEMBER 30.

ROYAL SOCIETY OF ARTS, at 3.—Capt. C. W. R. Knight: The Golden Eagle (Dr. Mann Juvenile Lectures) (1).

TUESDAY, DECEMBER 31.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (2): Making a Home.

WEDNESDAY, JANUARY 1.

ROYAL SOCIETY OF ARTS, at 3.—Capt. C. W. R. Knight: Wild Life in the Treetops (Dr. Mann Juvenile Lectures) (2).

CHILD-STUDY SOCIETY (at University College), at 5.30.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, JANUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (3): Building in Stone.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—

FRIDAY, JANUARY 3.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Eng. Vice-Admiral R. W. Skelton: Progress in Marine Engineering (Thomas Lowe Gray Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. G. Wellings and C. G. Mayo: Instrument Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

SATURDAY, JANUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (4): Boats and Furniture.

CONFERENCES.

JANUARY 1 TO 8.

EDUCATIONAL ASSOCIATIONS (at University College).

Wednesday, Jan. 1, at 3.—Prof. Winifred Cullis: The Lure of Investigation (Presidential Address).

EUGENICS SOCIETY.

Wednesday, Jan. 1, at 5.—Prof. E. W. MacBride: The Teaching of Biology in General Education.

CHILD-STUDY SOCIETY.

Wednesday, Jan. 1, at 5.30.—Dr. H. Crichton-Miller: The Study of the Child.

SCHOOL NATURE STUDY UNION.

Thursday, Jan. 2, at 3.—Dr. C. T. Green: Our Beautiful Wild Flowers.

NATIONAL COUNCIL FOR MENTAL HYGIENE.

Tuesday, Jan. 7, at 3.—Discussion: Preventable Mental and Physical Strains of School Life.

JANUARY 1 TO 4.

SCIENCE MASTERS' ASSOCIATION (at Imperial College of Science).

Wednesday, Jan. 1, at 8.15.—Prof. J. C. Philip: Presidential Address.

Thursday, Jan. 2, at 10.30 A.M.—A. F. Walden: Lecture on Liquids, with Discussion on Broadcasting.

At 6.—S. R. Humby: Lecture Experiments in Sound with an Electrically Controlled Source.

At 8.15.—Prof. W. A. Bone, assisted by R. P. Fraser: The Photographic Investigation of Flame Movements in Explosions (Lecture).

Friday, Jan. 3, at 9.30 A.M.—W. Corbridge: Lecture Demonstration on Some Home-Made Physical Apparatus.

At 10.45 A.M.—Dr. J. C. Munro: Industrial Biology (Lecture).

At 12.—Prof. Truscott and others: Discussion on Openings for College Trained Men in the Mineral Industry.

At 5.15.—Discussion with the Physical Society on Examinations in Practical Physics.

At 8.15.—Discussion on School Certificate Biology.

Saturday, Jan. 4.—Visits to the National Physical Laboratory and the Government Laboratory.

JANUARY 2 TO 6.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Thursday, Jan. 2, at 11.30 A.M.—Sir Henry G. Lyons: Presidential Address.

At 5.—Discussions:—Village Survey Making. Opened by Miss J. K. Jones.—The Inter-Relation of History and Geography in Central Schools. Opened by Miss D. Sarjeant.—Land Utilisation Map of Northampton. Opened by E. E. Field.

At 6.15.—H. E. Raynes: Mortality of Europeans in Equatorial Africa—A Study of the Effect of Improved Conditions and Mode of Life (Lantern Lecture).

Friday, Jan. 3, at 10 A.M.—Discussions:—The Physical Basis of Geography in Independent Schools. Opened by B. B. Dickinson.—Geography and the Training of Teachers. Opened by T. Herdman.

At 11.30 A.M.—Col. H. L. Crosthwait: Air Survey (Lantern Lecture).

At 2.30.—The Geography I was Taught, by Members of the Association.

Saturday, Jan. 4, at 10.30 A.M.—Sir E. J. Russell: Agricultural Developments in South Africa (Lantern Lecture).

At 11.45 A.M.—Dr. Vaughan Cornish: National Parks.

JANUARY 6 AND 7.

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).

Monday, Jan. 6, at 4.—B. L. Gimson and others: Discussion on Arithmetic of Citizenship.

At 5.30.—Prof. S. Chapman: The Use of Spherical Harmonic Functions in Mathematical Physics.

Tuesday, Jan. 7, at 10 A.M.—G. W. Spriggs and others: Discussion on Problems of Individual Education, with Special Reference to Work in Mathematics.

At 11.45 A.M.—Prof. W. M. Roberts: Gunnery and some of its Mathematical Problems (Lecture).

At 2.30.—Dr. W. F. Sheppard: Mathematics for Study of Frequency Statistics.

At 3.45.—Miss Hilda P. Hudson and others: Discussion on The Mathematician in Ordinary Intercourse.

EXHIBITION.

JANUARY 7, 8, AND 9.

ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science), from 3 to 6, and from 7 to 10.

Jan. 7, at 8.—Lord Rayleigh: Iridescent Colours in Nature from the Standpoint of Physical Optics (Lecture).

Jan. 8.—S. G. Brown: Gyro Compasses for Gun-Fire Control (Lecture).

Jan. 9.—Sir Ambrose Fleming: Television, Present and Future (Lecture).